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THE DIAGNOSIS OF BRONCHIECTASIS IN YOUNG ADULTS

PREBRONCHOGRAPHIC ROENTGEN MANIFESTATIONS OBSERVED AMONG MILITARY PERSONNEL

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BRONCHIECTASIS has been the most common chronic pulmonary condition at this Station Hospital. This has also been the experience of Thomas.[1] The high incidence during a period of a few months in a group of apparently healthy young men who had recently passed draft board examinations was surprising to us. Pulmonary tuberculosis appears to have been excluded far more effectively at induction stations. While tuberculosis is undoubtedly of great epidemiological importance, bronchiectasis carries with it a prognosis as serious for the life and health of the individual. From both military and industrial standpoints, with their similar responsibilities for disability compensation, bronchiectasis—its course characterized by repeated severe respiratory tract infections and culminating in early death—assumes a significance of more than academic interest.

Inasmuch as the recognition of bronchiectasis depends upon a critical estimate of the patient's history, clinical manifestations and roentgenographic observations, it seemed profitable to review our series particularly in regard to the prebronchographic roentgen manifestations in the lungs. For various reasons, the soldier's history as revealed by response to questioning proved in general to be unreliable and the roentgen data therefore assumed a more prominent rôle in raising the suspicion of bronchiectasis. Diamond and Van Loon[2] have similarly noted that "the clinical picture is not a reliable index of the degree of anatomic change." By and large, the patients in this series were admitted to the hospital with acute respiratory infections and were under a period of observation for some weeks or months before bronchograms were made. In the study of the roentgenograms obtained during this period, certain prebronchographic signs of bronchiectasis became evident. The roentgenograms were then reviewed to determine the reliability of these signs in the diagnosis of bronchiectasis.

The material consisted of 95 cases in which bronchograms had been made and where prebronchographic roentgenograms were available for examination. Frank

bronchiectasis was observed in 37 cases, minimal or questionable bronchiectasis in 24 and no bronchiectasis in 34. Of the 37 cases with frank bronchiectasis, the location was observed to be in the right lung in 13, in the left lung in 16 and bilateral in 8. A similar distribution was obtained with the minimal or questionable bronchiectasis included (Table 1).

TABLE I

LOCATION OF BRONCHIECTASIS

	Bronchiectasis		
	Minimal	Frank	Total
Right lung	13	13	26
Left lung	9	16	25
Both lungs	2	8	10
No bronchiectasis	—	—	34
Total	24	37	95

PREBRONCHOGRAPHIC ROENTGEN EVIDENCE OF BRONCHIECTASIS

Slowly Resolving Bronchopneumonia (Fig. 1*A* and 1*B*). The majority of the patients showed evidence of a basal bronchopneumonic infiltration on the initial roentgenogram. Often the symptoms were mild and the appearance of the lesion would have warranted the diagnosis of "primary atypical pneumonia" now acceptable in many quarters. Usually these small basal infiltrations resolve completely in a period of ten to fourteen days. When the lesion shows only partial resolution in two weeks and persists for three or four weeks or longer, bronchiectasis should be strongly considered. In this series a slowly resolving bronchopneumonia was observed in 28 of the 37 cases with frank bronchiectasis, in 14 of the 24 with minimal or questionable bronchiectasis and in 11 of the 34 where no bronchographic evidence of bronchiectasis was obtained.

Prominent Pulmonary Markings (Fig. 2). A frequent but less definite and reliable sign of bronchiectasis was the accentuation of the bronchial markings in the basal and peripheral lung fields. This was interpreted as a peribronchial infiltration. Normally the bronchial markings become very fine and inconspicuous as they approach the periphery of the lung but when they are accentuated just above the diaphragm and especially in the costophrenic sulcus, bronchiectasis may be suspected. The extent and character of the hilar and perihilar deposits do not seem to be of so much importance in this regard. A basal peribronchial infiltration is frequently observed in association with a slowly resolving bronchopneumonia. Prominent pulmonary markings of this character were observed in 29 of the 37 cases with frank bronchiectasis, in 13 of the 24 with minimal or questionable bronchiectasis and in 20 of the 34 with no bronchographic evidence of bronchiectasis.

Recurrent Bronchopneumonia (Fig. 3). A less common but nevertheless dependable sign of bronchiectasis was the observation of a pneumonia recurring in the same area of the lower lung fields after an interval of a few weeks or months. Undoubtedly if the observations had extended over a period of years, this would have been a more frequent and reliable indication of bronchiectasis. In our series a recurrent bronchopneumonia was found in 6 of the 37 cases with a frank bronchiectasis, and in 2 cases where no bronchiectasis was detected bronchographically.

Atelectasis (Fig. 4). For a number of years the association of bronchiectasis and atelectasis has been remarked. The recognition of a triangular segmental area of atelectasis in the lower medial lung fields, particularly in the course of pneumonia in children, has been described as a forerunner or accompaniment of bronchiectasis. The relationship of atelectasis and bronchiectasis has been examined experimentally by Tannenberg and Pinner.[3] They conclude: "A comparison of the experimental observations with the changes seen in human pathology makes it more probable that uncomplicated atelectasis per se has no bearing whatever on the development of bronchiectasis.

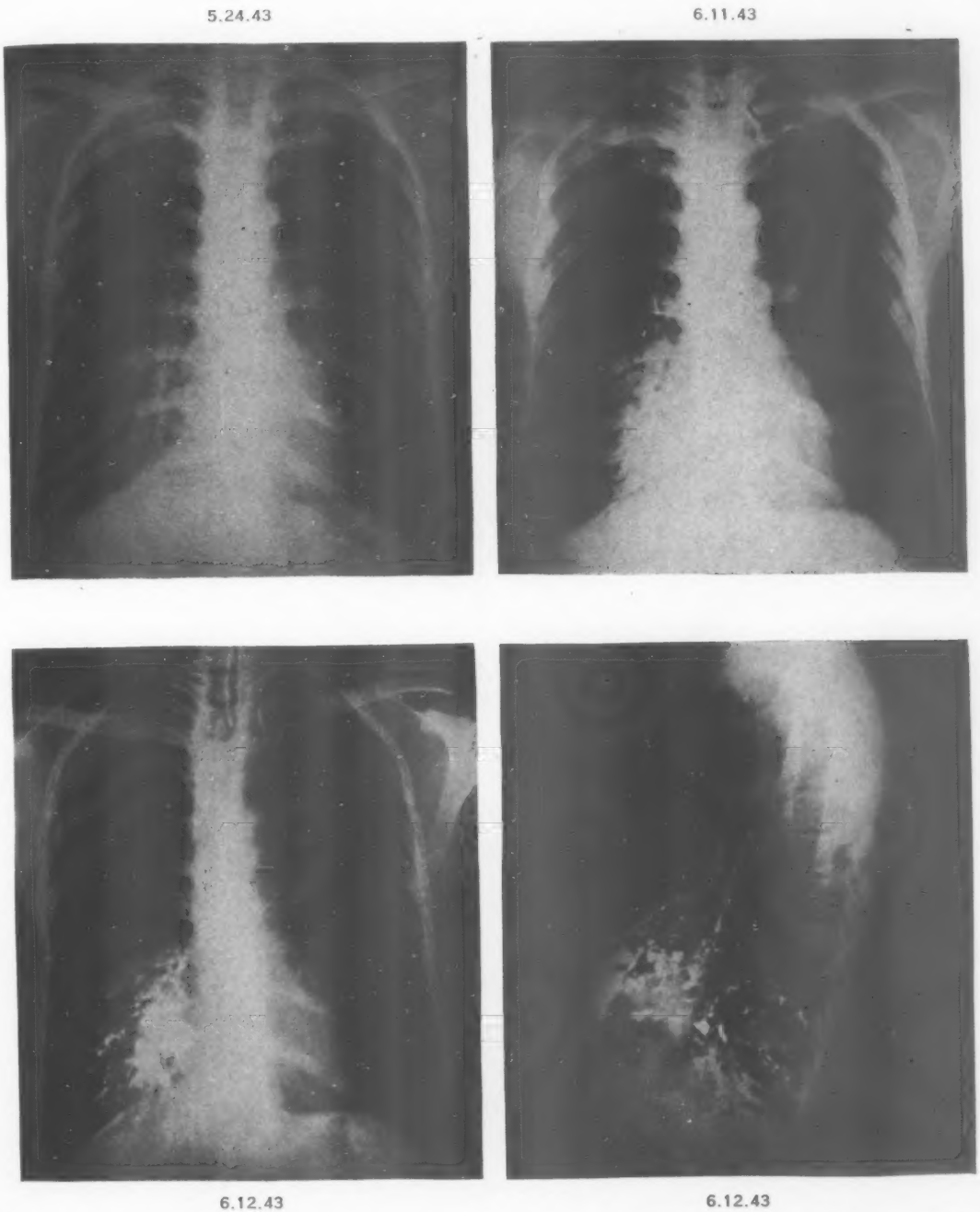

FIG. 1*A*. Basal bronchopneumonia persisting with very little change during a period of eighteen days, observed in a patient examined routinely for an over-age discharge. Inquiry elicited a history of mild, chronic productive cough following pneumonia in 1920. Bronchograms, made on the basis of roentgen interpretation, revealed an advanced saccular bronchiectasis with some atelectasis involving particularly the right middle lobe.

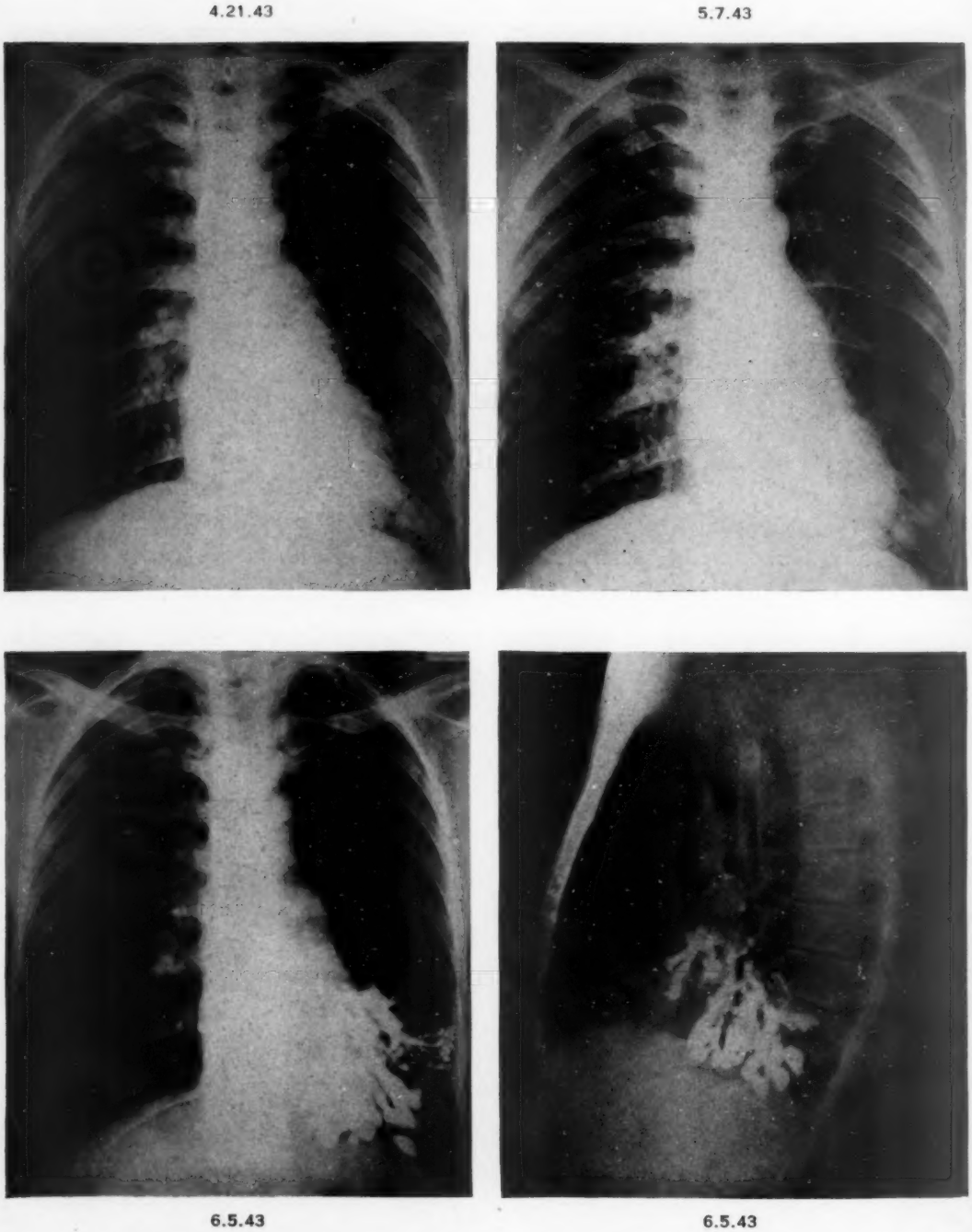

FIG. 1*B*. Bronchopneumonia at the base of the left lung without tendency to resolution during a sixteen day observation period in a patient admitted to the hospital with clinical evidence of acute respiratory infection. History disclosed three attacks of pneumonia in childhood, with occasional but mild subsequent respiratory infections. An advanced saccular bronchiectasis was demonstrated in the left lower lobe in bronchograms made on recommendation of the roentgenologist.

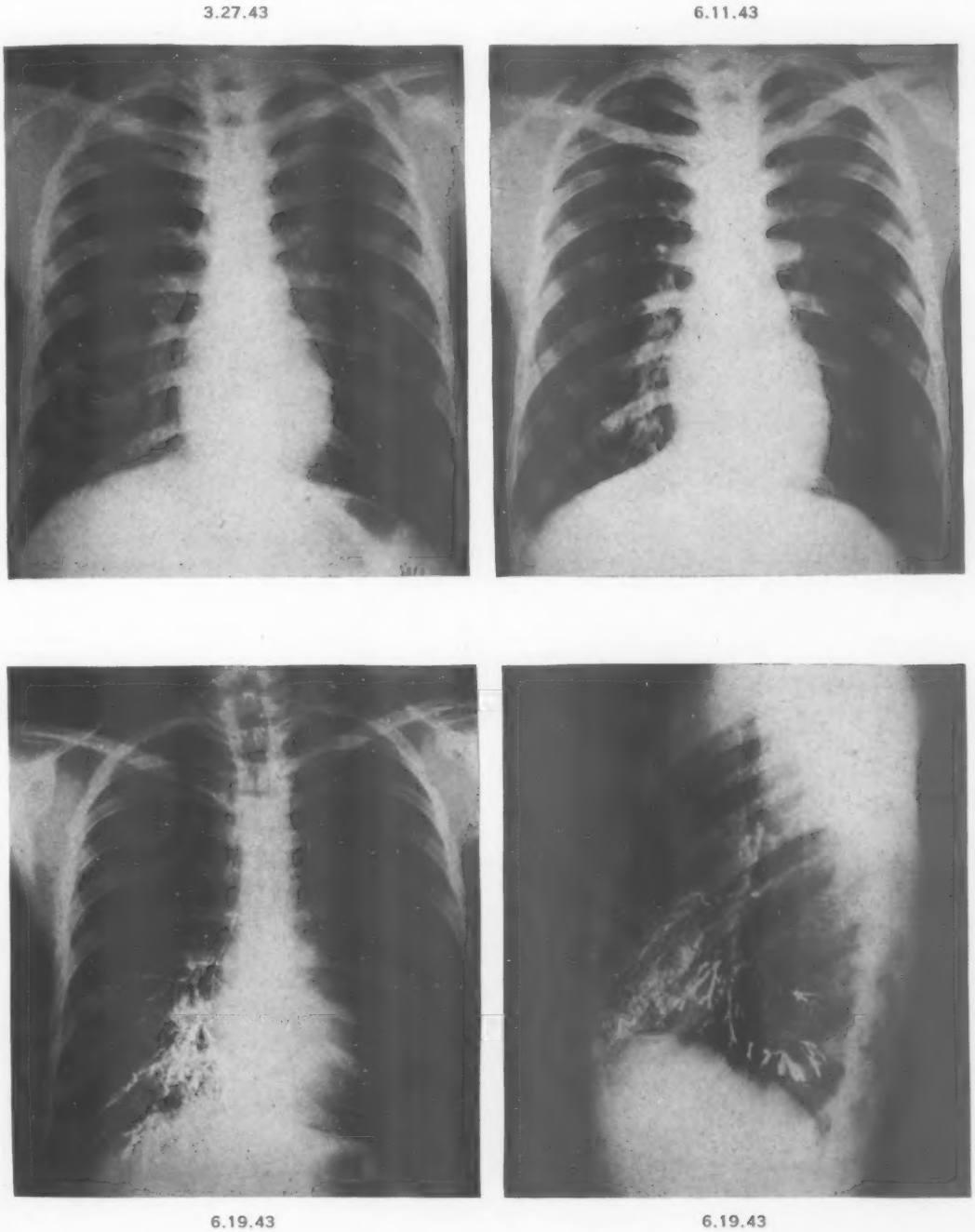

FIG. 2. Prominent bronchial markings observed in the lower medial portion of the right lung over a period of two and one-half months in a patient with no complaint but with a history of frequent respiratory tract infections associated with protracted moderately productive cough. Bronchograms made at the suggestion of the roentgenologist demonstrated a moderate cylindrical bronchiectasis at the base of the right lower lobe.

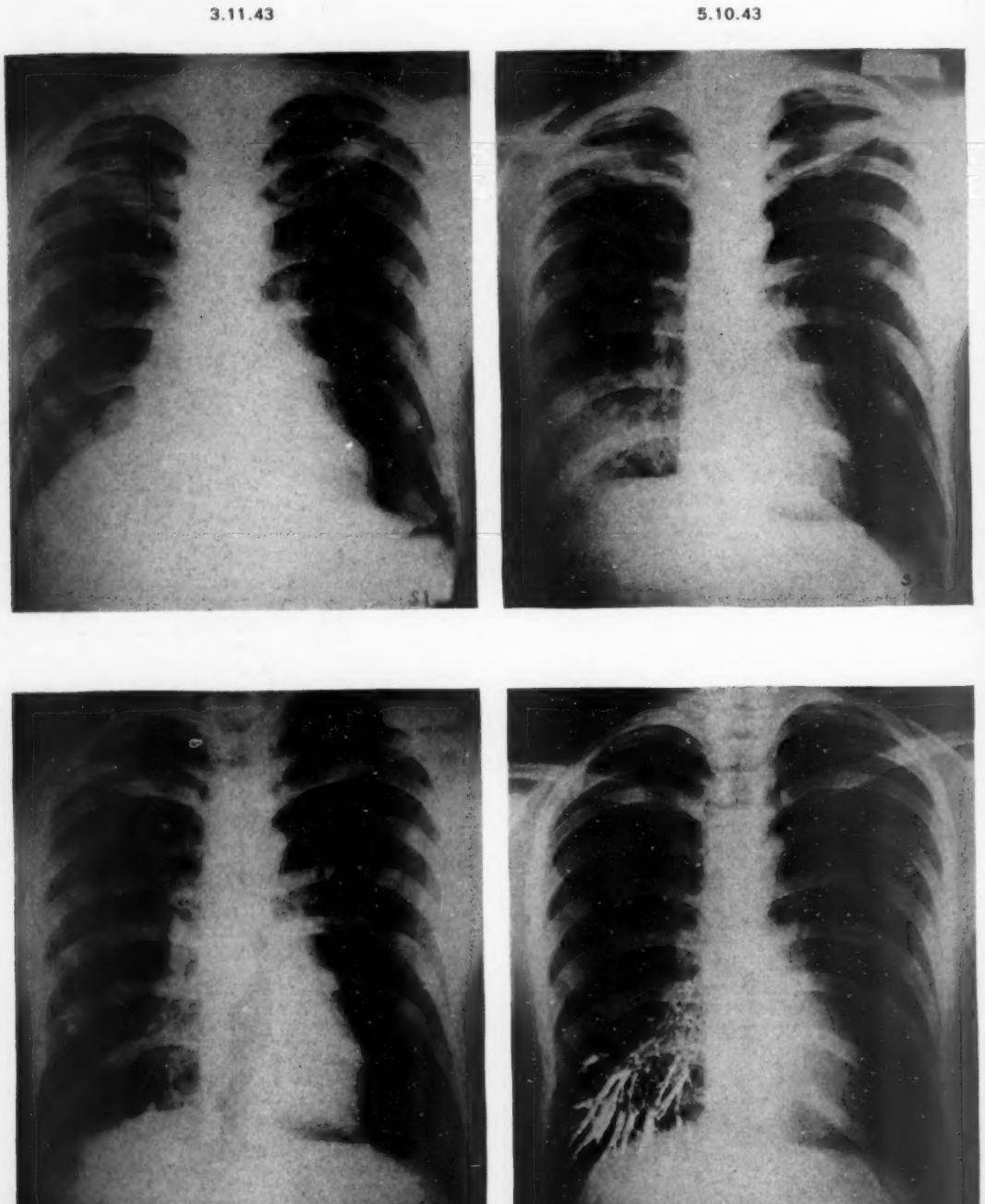

FIG. 3. Recurrent basal bronchopneumonia within an interval of two months and evidence of slow resolution with persistent peribronchial infiltration in the second attack. The patient gave a history of a severe pneumonia in childhood, but subsequent respiratory tract infections were infrequent and mild. The prebronchographic roentgenograms were considered strongly indicative of bronchiectasis and bronchograms demonstrated a cylindrical right lower lobe bronchiectasis.

There is, however, another relationship of these two conditions. Both may be produced by the same cause. Atelectasis in children and the other primary diseases which are found frequently in the history of bronchiectasis are caused almost without exception by inflammatory conditions in the lung. Bronchial exudate and inflammatory swelling of the bronchial mucosa may close the bronchial lumen and cause atelectasis within a short time." A sharply defined segmental area of complete atelectasis was not observed in this series but we were impressed by the occasional occurrence of a shrunken, contracted area of lung in the basal or lower medial lung fields. This was sometimes manifested by some degree of contraction of the thoracic cage as compared with the opposite side, but more often by a compression and retraction of the bronchial markings toward the base and mediastinum. The observation of this abnormal configuration of the bronchial tree was then confirmed bronchographically by the demonstration of the dilated bronchial radicles closely packed against the mediastinum or the dome of the diaphragm. This type of atelectasis would seem to be the result of a fibrosis in the involved pulmonary segment rather than the mechanical effect of simple bronchial obstruction. The prebronchographic evidence of a contracted lung was observed in 11 cases of the 37 with frank bronchiectasis, in 5 of the 24 with minimal or questionable bronchiectasis, and 3 of the 34 where no bronchiectasis was proved.

These data are summarized in Table II.

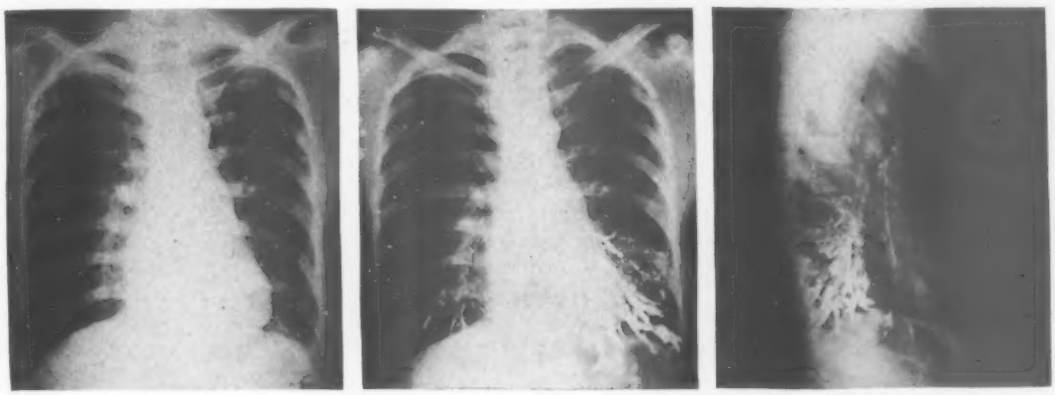

FIG. 4. Prebronchographic roentgenogram in a patient with an intermittent mild productive cough associated with common respiratory infections shows a contraction of the left lower chest and compression of the pulmonary markings at the base of the left lung toward the diaphragm and mediastinum. There was a history of pneumonia complicated by empyema on the left in 1937. Bronchograms show an advanced cylindrical and saccular bronchiectasis with a high degree of contraction of the left lower lobe, as revealed by the close proximity of the bronchial radicles.

BRONCHOGRAPHIC EVIDENCE OF BRONCHIECTASIS

In this study lipiodol was introduced into the bronchial tree by an oral cannula under indirect vision after cocainization of the oropharynx. The lipiodol was directed toward the part of the bronchial tree under suspicion by positioning the patient. The bronchographic demonstration of cylindrical and saccular dilatations of the bronchi to establish the diagnosis of bronchiectasis is generally accepted and requires no comment. Of particular interest to us was the detection of lesser changes in the group of patients classified as having minimal or questionable bronchiectasis. It is our assumption that no sharp distinction can be made between the normal and the ectatic

bronchus but that imperceptible gradations exist in the deviation from normal. It is not surprising, therefore, in consideration of minor variations of the normal pattern, that difficulty is encountered in determining what constitutes an abnormal bronchial tree and what evaluation should be assigned to these variations. What significance should be attached to the finding of one or two small saccular dilatations in the bronchial tree or to a slight irregularity in the contour of the lumen of a few small bronchial radicles or to an absence of the gradual diminution in caliber normally observed as the bronchus approaches the periphery of the lung?

The evaluation of such bronchographic signs depends upon our concept of bronchiectasis and this is subject to further enlightenment. Is bronchiectasis invariably progressive with more advanced involvement and the likelihood of a fatal termination if the abnormal lung is not removed, or may these minor bronchial abnormalities be self-limited, either being arrested in a harmless state or even regressing toward a normal pattern? The observation of these patients with minor bronchial abnormalities over a period of years may do much to elucidate our ideas on the pathogenesis and development of advanced bronchiectasis.

It was the observation of Diamond and Van Loon[2] that "Spread of the bronchiectatic process to previously uninvolved bronchi was not noted in any of the patients. The size of the existing dilatations remained unchanged in all but three. Reference has been made by Anspach and other investigators to the tendency of dilatations, when once formed, to increase in size with the passage of time. Whatever the tendency toward progression may be in adult life, it is clearly evident from the data in our series that such a tendency is not a prominent feature of bronchiectasis during childhood." These opposing views of Anspach and Diamond and Van Loon illustrate the difficulty in determining the "line of duty" status of bronchiectasis in the Army. It is our conception, in the light of the frequent history of childhood pneumonia, and of such studies as those of Diamond and Van Loon, that the bronchiectasis antedates the recent pulmonary infection, and probably has its origin in childhood. The rôle of whooping cough and pneumonia during childhood in the production of bronchiectasis is well recognized. Subsequent pneumonic infections may depend for their localization upon the presence of an underlying bronchiectasis. These infections represent therefore an incident in and a manifestation of the course of the disease

Table II

INCIDENCE OF PREBRONCHOGRAPHIC SIGNS

Sign	Bronchiectasis					
	None		Minimal		Frank	
	Most prominent sign only	Additional signs included	Most prominent sign only	Additional signs included	Most prominent sign only	Additional signs included
No sign	3	—	2	—	1	—
Slowly resolving pneumonia	17	11	12	14	20	28
Prominent pulmonary markings	13	20	10	13	8	29
Recurrent pneumonia	1	2	—	—	6	6
Contracted lung	0	3	0	5	2	11
Total	34		24		37	

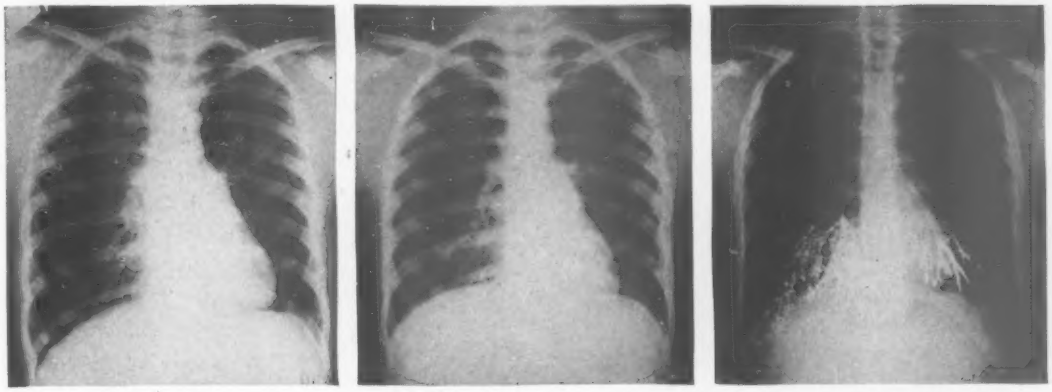

Fig. 5. Roentgenograms of the chest made during hospitalization for mild upper respiratory infection disclosed an abnormal appearance of the left lower lung field with a deficiency of the normal bronchial markings, suggesting a congenital cystic malformation. This was also observed at a subsequent examination five weeks later and bronchographic studies were suggested. Bronchograms revealed a bronchiectasis in the left lower lobe behind the heart, with a contraction of this portion of the lung and a compensatory emphysema of the adjacent lung. No characteristic symptoms or signs of this condition were elicited.

rather than a factor in its production and development.

Correlation of the Prebronchographic and Bronchographic Roentgen Signs

An analysis of the tabulated results (Table III) revealed that bronchiectasis as demonstrated by bronchography could be predicted with reasonable accuracy from a study of the prebronchographic roentgenograms. A fairly close correlation was obtained in 32 cases with frank bronchiectasis, in 21 with minimal or questionable bronchiectasis, and in 26 where no bronchiectasis was discovered. A poor correlation was found in 5 cases having a frank bronchiectasis, in 3 with minimal or questionable bronchiectasis, and in 8 with no bronchographic evidence of bronchiectasis. There was therefore a tendency to suspect bronchiectasis somewhat more frequently than confirmation could be obtained bronchographically. In some instances, a more accurate prebronchographic diagnosis could probably have been achieved if there had been a longer preliminary observation with serial roentgenograms. Two cases are illustrative of positive and negative errors that were made. In one (Fig. 5) bronchiectasis was discovered in the bronchographic study of what was thought to be a congenital malformation of the lung. The malformed lung proved to be an emphysema secondary to a contracted bronchiectatic area of lung behind the heart. In the other (Fig. 6) there seemed to be adequate evidence to warrant a diagnosis of bronchiectasis, which could not, however, be confirmed bronchographically. It thus seems to us advisable to seek bronchographic confirmation of a diagnosis of bronchiectasis, however strong the suspicion for such a diagnosis may have been from previous clinical roentgen studies.

Table III

Correlation of Prebronchographic Signs with Bronchographic Evidence of Bronchiectasis

	Bronchiectasis			Total
	None	Minimal	Frank	
Good correlation	26	21	32	79
Poor correlation	8	3	5	16
Total	34	24	37	95

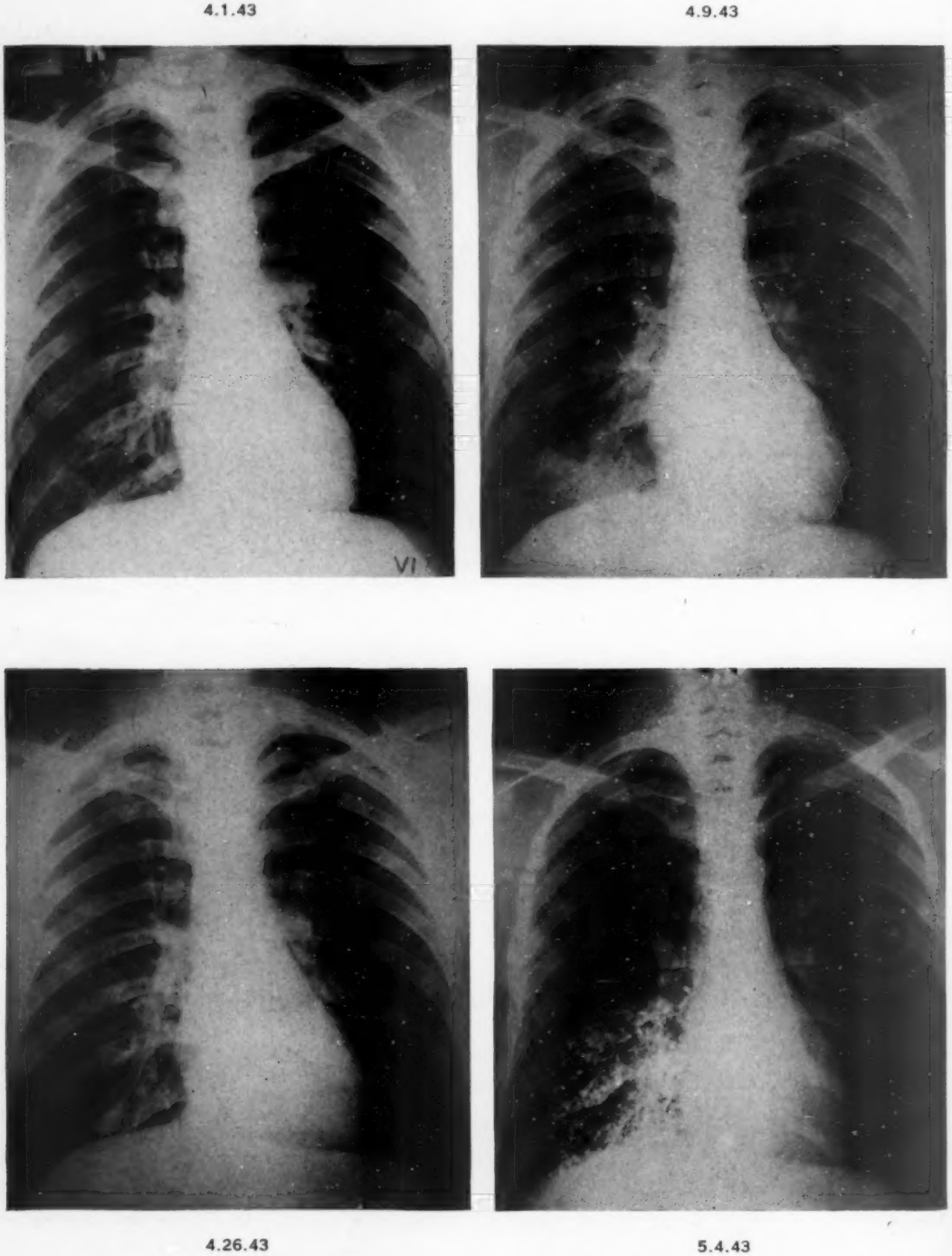

FIG. 6. A low grade, slowly resolving basal bronchopneumonia in the right lung observed in a patient with no significant antecedent respiratory history. The slow resolution was accompanied by a persistent peribronchial infiltration and some contraction of the involved lung. No bronchiectasis was demonstrable.

CONCLUSIONS

1. The more frequent recognition of bronchiectasis derives from an awareness on the part of the clinician and roentgenologist that the condition may exist in the absence of the classical signs and symptoms.

2. The observation in serial roentgenograms of a slowly resolving basal bronchopneumonia, recurrent basal bronchopneumonia, persistent basal peribronchial infiltration, and a contracted segment of lung, either singly or in combination, warrants a suspicion of bronchiectasis.

3. With serial roentgen studies during a period of several months a reasonably accurate diagnosis of bronchiectasis may be made, but

4. Bronchographic studies are necessary to confirm the diagnosis.

5. Observation of patients with minimal bronchial changes during a period of years is desirable to learn the significance of these changes.

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ORNITHOTIC PNEUMONIA*

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IT IS becoming increasingly apparent from the recent reports of Meyer,[4] Meyer and Eddie,[5] Meyer, Eddie and Yanamura,[6] Smadel,[7] Favour[3] and others[1,2] that many of the so-called cases of atypical or virus pneumonia are due to a psittacine or psittacine-like virus. Smadel[7] found at least 10 of 45 sporadic cases of atypical pneumonia in large eastern urban populations to be due to infections with strains of the virus of psittacosis. Favour[3] makes some interesting speculations:

If it is true that bacteria-free atypical pneumonia other than ornithosis was not known before 10 years ago, one of the ornithosis viruses might be offered as the progenitor of human atypical pneumonia, having become so established as a result of the 1929–30 psittacosis epidemic. This presumes a very rapid adaptation in man. It is more likely, however, that atypical (virus) pneumonia is an ancient disease. As in endemic Australian ornithosis, perhaps some strains of the virus of human atypical pneumonia are well adapted to homogeneous human infection chains, while other strains, like the South American ornithosis virus, still require heterogeneous hosts to insure their perpetuation, and therefore may be passed to experimental animals.

The value of the work and reports of Meyer and others on the subject of ornithosis cannot be overestimated. Were it not for such recent reports our examples of ornithosis would probably have been considered as cases of primary atypical pneumonia, etiology unknown. Awareness of the possibility of such an infection led to further questioning of the patients, which in at least 2 of our 3 cases revealed pertinent facts, and investigation of the patients' sera for ornithosis.

CASE REPORTS

CASE 1.* B. L. (110203), male, aged sixty-six, entered the hospital on March 23, 1941, soon after having returned to Milwaukee from a vacation in Florida and Georgia where he visited with many friends who were engaged in farming occupations. The patient stated that his illness dated back to January, 1941, but four weeks previous to entering the hospital he had the "flu" with severe sore throat and enlarged glands in the neck. Soon after the "flu" had subsided his knees, ankles and left elbow became swollen, stiff, painful and slightly reddened. Massage and heat therapy offered only slight relief.

The patient was a retired cattle dealer, having retired a few years before the onset of this illness.

Examination. The patient did not appear acutely ill when he entered the hospital; he lay quietly in bed. His blood pressure was 110/70, temperature 101.1° F., pulse 100, respirations 22. Physical examination of the chest was essentially negative. Both knees, both ankles and the left elbow were swollen, tender, reddened, and showed limitation of motion. The clinical impression was acute rheumatic fever.

Laboratory Data. The red blood cell count on admission was 3,810,000 per cu. mm., hemoglobin 12 grams, leukocytes 31,300 per cu. mm. with 95 per cent polymorphonuclear leukocytes. The red blood cells showed stippling, slight toxic degeneration, slight polychromatophilia, poikilocytosis, anisocytosis, and hypochromia. The sedimentation rate of the red blood cells was 48 per cent in fifteen minutes, 40 per cent in thirty minutes, 37 per cent in sixty minutes. The blood Kline reaction was negative. Agglutination tests for typhoid and paratyphoid fever and undulant fever were also negative. Blood cultures were sterile seven days after inoculation.

* Referred by Dr. C. E. Bellehumeur.

* From the Department of Radiology and Department of Medicine, Mount Sinai Hospital, Milwaukee, Wisconsin.
† Captain, M.C., A.U.S.

A roentgenogram of the chest taken April 7, 1941 (Fig. 1), approximately two weeks after admittance to the hospital or six weeks after the attack of "flu," showed a diffuse veil-like shadow overlying the entire left chest. The underying lung detail was not clearly discernible. The left diaphragm and costophrenic space were obscured. A few suggestive infiltrations were seen in the base of the right lung. The roentgen appearance of the chest was indicative of a diffuse pleural reaction on the left side with a possible underlying pneumonic process. Suggestive areas of bronchopneumonia were also present in the right base.

Course. With the exception of slight elevation during the first two days in the hospital, the patient's temperature was normal for a period of approximately one week. It then began to rise steadily until it reached 105° F. The temperature was elevated for two weeks and then fell rather sharply to 100° F. and slowly returned to normal after a few days.

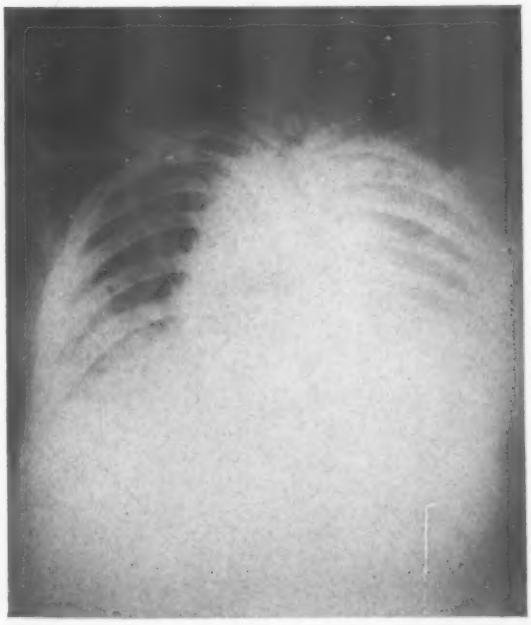

Fig. 1. Case 1. Portable chest roentgenogram taken April 7, 1941. Obscuration of entire left chest by large pleural effusion. Infiltrations in right base.

Electrocardiographic tracings made on May 29, 1941, showed a tendency to right axis deviation with merely suggestive evidence of myocardial involvement. The tracings were not repeated.

Barium enema examination was performed April 14, 1941, after the patient developed some abdominal distention. There was no evidence of an organic lesion in the colon.

Fig. 2. Case 1. Roentgenogram made April 30, 1941, approximately five weeks after admission to hospital. Slight pleural reaction still present in left lower lateral chest region.

Sulfadiazine administration showed no apparent effect on the course of the disease. Supportive and symptomatic treatment including a blood transfusion was administered. The high white blood cell count and polymorphonuclear leukocytosis persisted throughout the hospital confinement.

Subsequent chest roentgenograms taken April 15, 21 and 30, 1941 (Fig. 2) showed gradual resolution of the pneumonic and pleural processes, the latter on the left side.

The patient was discharged from the hospital in apparently good condition on May 1, 1941, forty days after admission or approximately nine weeks after the onset of "flu."

Follow-up Record. During the month of November, 1941, the patient complained of joint pains and weakness. Although the patient had no knowledge of contact with infected birds, Dr. J. S. Goodman submitted a sample of blood serum to Dr. K. F. Meyer of George Williams Hooper Foundation, University of California, San Francisco. Dr. Meyer promptly reported a 4 plus complement fixation reaction

FIG. 3. Case II. Roentgenogram taken May 23, 1942, approximately eight days after onset of illness, shows a circumhilar shadow on left side.

with psittacine antigen in a dilution of 1:32. The reaction was checked by tests with a second specimen of blood serum and Dr. Meyer remarked that there was no doubt in his mind that the patient suffered from ornithosis and that the original infection probably occurred during the early part of the year 1941.

As far a can be determined at the present time the patient is in good health and fully recovered from this illness.

CASE II. *Mrs. R. R. (118060), aged fifty, was admitted to Mount Sinai Hospital on May 23, 1942. One week before admission the patient contracted a "cold" and began to complain of malaise, joint pains and dull pain in the lower abdomen. On May 20, 1942, the visiting physician made a diagnosis of early pneumonia.

The past history as obtained from the patient on admission to the hospital was essentially negative except for a history of chronic gallbladder disease.

Examination. Physical examination revealed an elderly, fairly well nourished, white female, rather gravely ill and showing a slight degree of cyanosis. Her skin was hot and dry. Some pharyngitis was present. Physical examination of the chest was essentially negative. Abdominal palpation revealed some tenderness in the left lower abdomen and evidence of splenic enlargement. The blood pressure was 120/66, temperature 101.2° F., pulse 94, respiration rate 20. The clinical impression on admission was central pneumonia or septicemia.

Laboratory Data. Blood determinations showed the following: Hemoglobin 12.5 grams, red blood cells 3,940,000 per cu. mm., leukocytes 7,600 per cu. mm., polymorphonuclears 75 per cent, lymphocytes 18 per cent, basophiles 1 per cent, stippled red blood cells, polychromatophilia, toxic granulation and slight anisocytosis. Urinalysis showed a slight trace of albumin and a fairly large number of leukocytes (25 or 30) per high power field. The sedimentation rate of the red blood cells was 53 per cent in fifteen minutes, 43 per cent in thirty minutes and 38 per cent in one hour. The blood Kline test was negative.

A roentgenogram (Fig. 3) of the chest made May 23, 1942, the day of admission to the hospital, showed a circumhilar area of increased density measuring approximately 6 cm. in diameter on the left side. No other definite abnormality was noted in the lungs. Roentgenologically, one was unable to differentiate between central or hilar pneumonia, lung abscess or even lung neoplasm.

Course. The patient's condition became progressively worse during the following two weeks. The temperature ranged between 100.0 and 105.8° F., rectally. Occasionally the patient complained of chilly sensations. Blood culture

FIG. 4. Case II. Fan-shaped involvement of left upper pulmonary lobe three days following first roentgen examination.

* Referred by Dr. N. A. Gendlin.

showed no growth seven days after inoculation. Throat culture showed predominance of *Streptococcus viridans*. Gastric washings were negative for acid-fast bacilli. Culture of a small amount of material obtained by thoracentesis was sterile seventy-two hours after inoculation.

Roentgen examination of the chest on May 26, 1942 (Fig. 4), approximately ten days after the onset of the disease, showed more extensive and fan-shaped involvement of the left upper lobe.

A roentgenogram of the chest on June 4, 1942 (Fig. 5), approximately two weeks after the original examination or three weeks after the onset of illness, showed almost complete resolution of the pathologic condition previously described in the left subclavicular region, but definite evidence of the pneumonic process was noted extending downward and outward from the hilar zone in the right lung. Some peripheral clouding of the left base was also noted. The roentgen appearance of the lungs was consistent with a diagnosis of atypical (virus) pneumonia, etiology unknown.

The patient showed no apparent satisfactory or favorable response to any of the therapeutic measures employed. Sulfadiazine, sulfanilamide and sulfathiazole were administered on various occasions in doses of 15 grains every four hours. Streptococcus convalescent serum showed no effect. Three deep roentgen treatments were given to the left chest and one treatment was given to the right chest without any effect on the clinical course. Several blood and plasma transfusions were given. The white blood cell count never rose above 8,600 per cu. mm.

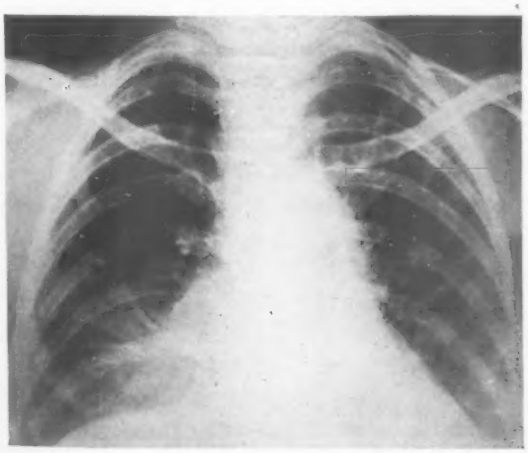

Fig. 5. Case II. Roentgen appearance of chest on June 4, 1942, three weeks after onset of disease. Almost complete resolution of left upper lobe pneumonic process. New infiltrations extending downward and outward from lower right hilar region.

Fig. 6. Case III. Roentgenogram of chest (May 20, 1943) shows faint bronchopneumonic areas in the right base.

Agglutination tests for typhoid and paratyphoid fever and brucellosis abortus were negative. Further questioning of the patient, approximately two weeks after the patient was admitted, revealed that the patient had handled and eaten pigeons two weeks before entering the hospital. Blood serum was then immediately sent to Dr. K. F. Meyer, George Williams Hooper Foundation, for complement fixation tests for psittacosis. Dr. Meyer reported a 4 plus reaction in dilution of 1:64 and a 3 plus reaction in a dilution of 1:128. The serum, in Dr. Meyer's opinion, was strongly positive for psittacosis.

The patient began to improve after three weeks of hospitalization and a subsequent roentgen examination of the chest on June 19, 1942, showed very few residual pulmonary infiltrations in either lung. The patient was discharged from the hospital on July 4, 1942, in good condition. The duration of this patient's illness was approximately six weeks.

Case III. *Mrs. M. F. (126983), aged fifty-three, entered the hospital on May 16, 1943, complaining of fever and left frontal headaches of one week duration. The patient stated that the fever ranged between 101 and 103° F.

* Referred by Dr. L. L. Grossmann.

Many years ago the patient claimed she had typhoid fever which resulted in partial permanent deafness.

Examination. The patient was a white, well nourished, somewhat dehydrated female appearing subacutely ill. The temperature was 100.6° F., pulse 104, respirations 24 per minute, and blood pressure 148/90. The patient wore a corrective auditory appliance for a moderately severe degree of deafness. Transient râles were noted in the right lower chest posteriorly. There was no evidence of hepatosplenomegaly nor evidence of lymphadenopathy. The clinical impression on admittance to the hospital was a virus infection.

Laboratory Data. The blood hemoglobin on entrance to the hospital was 15.5 grams and the white blood cell count was 13,750 with 81 per cent polymorphonuclears. The blood Kline reaction was negative. Examination of the urine showed 10 to 12 leukocytes and 4 to 6 red blood cells per high power microscopic field. Sedimentation rate determinations showed 73 per cent in fifteen minutes, 44 per cent in thirty minutes and 41 per cent in one hour.

The roentgenogram of the chest (Fig. 6) dated May 20, 1943, showed faint bronchopneumonic infiltrations in the right base. Roentgen examination of the skull and paranasal sinuses was essentially negative.

Course. The course in the hospital was uneventful and the patient's only complaint was marked weakness. There were no complaints referable to the chest. During the first week of hospitalization the temperature ranged between 99° and 102° F. The fever began to fall after the first week in the hospital and when the patient was discharged on May 27, 1943, twelve days after admission, the temperature was normal.

Agglutination tests were negative for typhoid and paratyphoid groups. A blood culture started May 17, 1943, showed no growth for seven days.

Further questioning of the patient yielded the information that the patient's husband was a dealer in domestic pigeons. On May 21, 1943, therefore, blood serum was sent to the U.S. Public Health Service, Washington, D. C., for psittacosis agglutination tests. The results reported were a 4 plus reaction in a dilution of 1:32, 3 plus in a dilution of 1:64 and 2 plus in a dilution of 1:128. Another sample of serum was sent out on June 19, 1943, and the tests showed a 4 plus reaction in a dilution of 1:64, and a 3 plus reaction in a dilution of 1:128. This definite increase in titer over that of the specimen which was sent one month previously justified the laboratory diagnosis of ornithosis.

The patient's husband refused to have blood taken for complement fixation tests for ornithosis.

COMMENT

Meyer states that close to fifty species belonging to five large orders in class Aves may spontaneously be infected with the psittacosis virus. Therefore, we believe that Meyer's[1] suggestion as to the proper terminology of this disease should be adopted. The term psittacosis should denote infections with a proved virus of psittacine origin while ornithosis should include human and bird infections due to psittacosis-like agents of non-psittacine derivation.

Complement fixation tests have proved that many of the influenza-like, mild, atypical infections are due to ornithosis. Meyer states that frank human infections are infrequent because (1) insufficient amounts of the virus are discharged except by ill pigeons and (2) the viruses are of low pathogenicity. The disease is usually transmitted by sick birds but human to human transmission of this disease occurs. Second attacks of ornithosis are also possible.

The incubation period is seven to fourteen days with signs of a generalized infection developing rapidly thereafter. In the early stages the typhoidal state is simulated, the pulse usually being relatively slow. Clinically, Favour classifies the disease into three types. The disease may occur in a very mild form and last one to two weeks. The pulmonary involvement is usually represented by a central pneumonia. Our third patient (Mrs. M. F.), an example of the mild form of ornithosis, however, showed faint bronchopneumonic infiltrations in the right lower lung.

The moderately severe type of ornithosis is the typhoidal state where the clinical course is more prolonged, usually lasting

three to four weeks. The pulmonary involvement is usually central at first, then a migrating pneumonitis. Our second case (Mrs. R. R.) showed early in the course of the disease a central pneumonic process in the left upper lobe. Subsequently the patient developed more extensive involvement of the left upper lobe, then extension into the right lung and left base.

Mortalities occur in the third and most severe type of ornithosis. This group shows about 30 per cent mortality. The course is more prolonged and widespread pneumonic involvement is characteristic. Mr. B. L., Case I, showed widespread pneumonic involvement with a pleural effusion. In addition, this patient complained of polyarthritis and peripheral lymphadenopathy and later suffered a relapse, the latter being not infrequently observed in this disease.

Clinically speaking, the most striking feature of this disease is the comparative lack of chest complaints in the presence of often widespread pneumonic changes. The subjective complaints are mainly those of weakness and malaise, simulating influenza. Cyanosis is often out of proportion to the amount of lung involvement. Abdominal distention might occur as it did in one of our patients but no localizing signs are present. Polyarthritis and pleural effusions are quite rare.

The white blood cell count is usually low or within normal limits but in 2 of our cases it was slightly to markedly increased. Perhaps secondary infection was responsible for the elevated white blood cell counts in these 2 cases.

If evidence of contact with infected birds becomes established one might suspect an ornithotic infection but confirmation by complement fixation tests for ornithosis is necessary. It is also perhaps advisable to follow the rather rigid criteria laid down by Smadel in order to prove ornithotic etiology. These criteria are (1) isolation of virus during the acute phase of the disease, or (2) the demonstration of the appearance of complement fixing antibodies during convalescence or of a significant rise in titer of these antibodies during the period of recovery. Smadel attaches significance to the results of the complement fixation tests only if there is a fourfold or more rise in antibody titer during convalescence.

Like the clinical aspects of the disease, the roentgen appearance of the chest in ornithosis is similar to that of human atypical pneumonia. The typical case of ornithosis, as Favour describes it, presents a central, patchy, migrating pneumonitis. Case II started as a central pneumonic process in the left upper lobe and later involved the entire left upper lobe, the right lower lung and the left base. Case III, although examined only on one occasion, showed bronchopneumonic areas in the right base. Case I showed bilateral pulmonary involvement with a left pleural effusion.

Roentgenographically it might be difficult and perhaps impossible, early in the course of the disease, to differentiate between ornithotic pneumonia, early lung abscess, early lobar pneumonia or a mediastinal new growth. Serial roentgenograms of the chest, more thorough questioning of the patient, the clinical course of the disease and the all important complement fixation tests for ornithosis will make differentiation possible.

One of our patients (Case II) received a few deep roentgen treatments to the chest. No apparent effect on the clinical course or pneumonic process was noted.

SUMMARY

Three cases of ornithosis with demonstrable pulmonary changes are presented. These examples of ornithosis are presented in an effort to emphasize the fact that many cases of so-called atypical pneumonia, etiology unknown, are actually due to a psittacine or psittacine-like virus; the frequency of such an infection is undoubtedly underestimated. Complement fixation tests for ornithosis should be performed in all

cases of atypical pneumonia even in the absence of known contact with infected or sick birds.

CONCLUSION

The term "primary atypical pneumonia, etiology unknown" should be reserved for cases of atypical pneumonia only after they have been thoroughly investigated from all etiological standpoints including complement fixation tests for ornithosis.

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PRIMARY CANCER OF THE LUNGS*

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IN VIEW of the increasing incidence of cancer of the lungs and the improved methods of diagnosis now in universal use, the value of keeping this subject before the medical eye seems to be of increasing importance.

This is primarily a statistical study of the 260 cases of cancer of the lung that have been cared for at New York Hospital since 1932 and a detailed account of 100 of these patients with a tissue diagnosis of primary carcinoma of the lung obtained either by biopsy or at postmortem. For analysis, the postmortem diagnosis is given a preference over all other procedures where a tissue diagnosis has been obtained by more than one means.

Of these 100 cases (Table 1) 62 were examined at necropsy, 25 were diagnosed by bronchoscopic biopsy and 7 were proved by the examination of tissue removed at thoracotomy. Five cases were diagnosed by microscopic examination of tissue obtained by an aspiration biopsy. Of the 160 cases excluded from this study, the majority were probably primary lung tumors but no histological proof was available.

Table II shows the sex incidence and the age groups of the 100 cases. There were 88 males and 12 females, which is a greater preponderance of the disease in males than reported by Halpert[1] who found a 5 to 1 ratio of males to females affected, but not as high as 90.3 per cent of males that Craver[2] reported in his series of 175 cases.

The analysis of age groups reveals 36 per cent in the sixth decade but the fifth decade shows 32 per cent, which indicates that the disease occurs in relatively young individuals. The average age at the time of admission was 52.5 and the extremes were twenty-seven and seventy-eight years.

TABLE I

DIAGNOSTIC PROCEDURES

Cases analyzed	260
Cases proved by tissue examination	100
Cases examined postmortem	62
Cases diagnosed by bronchoscopic biopsies	25
Cases diagnosed by thoracotomy	7
Cases diagnosed by aspiration biopsy	5

TABLE II

SEX INCIDENCE AND AGE GROUPS

Males	88
Females	12
Age Groups	
20–29	1
30–39	8
40–49	32
50–59	36
60–69	20
70–79	3

TABLE III

SIGNS AND SYMPTOMS

Cough	84
Fever	81
Weight loss	72
Dyspnea	58
Weakness	54
Pain in chest	51
Hemoptysis	48
Anorexia	47
Pulmonary osteoarthropathy	31
Effusion	27
Vomiting	17
Cyanosis	16
Chills	15
Paralysis of diaphragm	14
Nausea	10
Horner's syndrome	7

* Material obtained when the authors were attached to the Department of Radiology, New York Hospital, New York, New York.

Table III shows the signs and symptoms presented by these 100 patients. There has been no attempt to list these chronologically but they were the signs and symptoms presented at the time of the patients' admission to the hospital; cough, fever, and weight loss were the most common complaints which explains why many of the patients with carcinoma of the lung come to a general hospital as a diagnostic problem forcing the clinician to turn to such aids as roentgenology, bronchoscopy and aspiration biopsy to solve the problem.

TABLE IV

DIAGNOSTIC PROCEDURES

Cases bronchoscoped	55
Positive tissues obtained	39
Cases roentgenographed	100
Cases suspected by roentgen ray	86
Cases not suspected by roentgen ray	14
Thoracotomies	32
Curative procedures attempted	7
Aspiration biopsies attempted	7
Aspiration biopsies positive	5
CASES CORRECTLY DIAGNOSED	96

TABLE V

ROENTGENOGRAPHIC TYPES

Main and primary bronchial	70
Peripheral	12
Superior sulcus	8
Segmental	5
Diffuse	2

Three cases did not produce roentgen evidence

TABLE VI

CHEST COMPLICATIONS

Pneumonia	34
Lung abscess	32
Bronchiectasis	15
Pleural effusion	15
Empyema	14
Bronchopleural fistula	8

TABLE VII

COURSE

Average duration of life from first symptom until death	8.1 mo.
Cases examined postmortem	62
Cases known dead without postmortem	31
Cases living	5
Cases lost to follow-up	2

In this entire list of signs and symptoms the only definitely localizing information we have is paralysis of the diaphragms, which is usually a late finding, and Horner's syndrome, which occurred only in superior sulcus tumors. Horner's syndrome was found 7 times in 8 tumors of the Pancoast type and was accompanied by pain in the shoulder and arm of the affected side in 6 of the patients. Three patients who had carcinoma of the upper lobe which were not of the superior sulcus type had shoulder and arm pain and 1 patient with a left lower lobe bronchus tumor had right shoulder pain.

In a few cases the metastases were responsible for the pain at the time of admission. Two of the 3 patients with headache had cerebral metastases, 1 with abdominal pain had liver and pleural metastases and 1 with back pain had vertebral involvement. There was 1 patient with generalized pain produced by widespread metastases.

Table IV lists the diagnostic procedures employed and the results obtained.

In 39 of the 55 cases bronchoscoped, tissue was obtained which revealed carcinoma on microscopic examination. This represents positive results in 71 per cent of the cases done and 39 per cent of the proved cases. But it shows that positive bronchoscopic biopsies were obtained in only 15 per cent of 260 cases available for study at New York Hospital since 1932. Lack of physical signs pointing to bronchial obstruction and masking of the obstruction by complications is probably the reason why so few bronchoscopies were done.

Roentgenography is an extremely important diagnostic procedure. It is, however, unlike bronchoscopy in that it is never absolutely diagnostic but usually suggestive. There were 14 of our cases in which primary carcinoma was not suspected at the roentgenographic examination.

Thoracotomy was done in 32 cases. Seven curative procedures were attempted and 2 of these can be considered to have been ultimately successful. The other 25

thoracotomies consisted of drainage of lung abscesses or empyema or exploratory operations at which inoperable cancer was encountered.

Although only 7 aspiration biopsies were attempted the record of 5 positive results makes this procedure very valuable, as Craver has already emphasized. It must be realized that the chief limitation of aspiration biopsy is the technical difficulty of obtaining tissue from central lesions which are much more common than those developing in the periphery. But herein lies also the chief value of aspiration biopsy for it can be used to secure tissue where bronchoscopy fails.

Roentgenographically, we have been able to divide these cases into five groups, depending on the location of the carcinoma. By far the most common is the central type which made up 70 per cent of our cases and which originates in the main bronchi and their primary branches. The first signs and symptoms of these tumors are those associated with stenosis of the large bronchi producing collapse pneumonitis and suppuration of the lung distal to the bronchial occlusion. Roentgenographically these produce varying appearances depending on the bronchus involved.

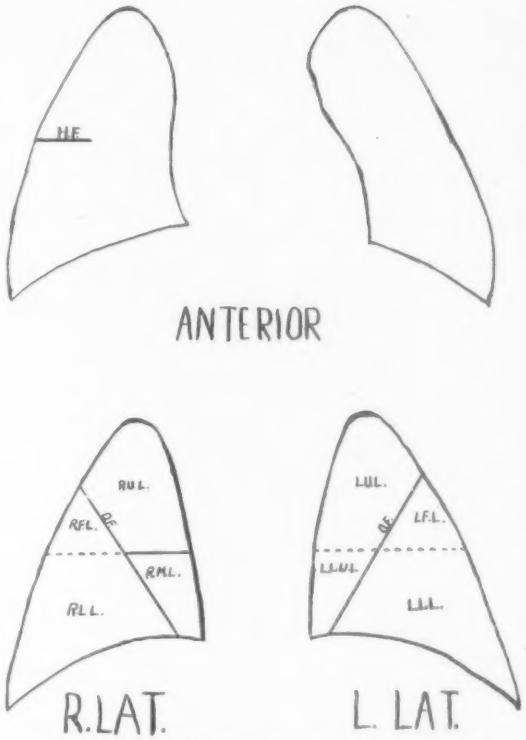

Fig. 1. Diagram of the normal anatomy of the lungs demonstrating the four lobe concept of lung anatomy. *R.U.L.*, right upper lobe; *R.M.L.*, right middle lobe; *R.L.L.*, right lower lobe; *H.F.*, horizontal fissure; *L.U.L.*, left upper lobe; *L.L.U.L.*, lingula of the left upper lobe; *L.L.L.*, left lower lobe; *R.F.L.*, right fourth lobe; *L.F.L.*, left fourth lobe; *O.F.*, oblique fissure.

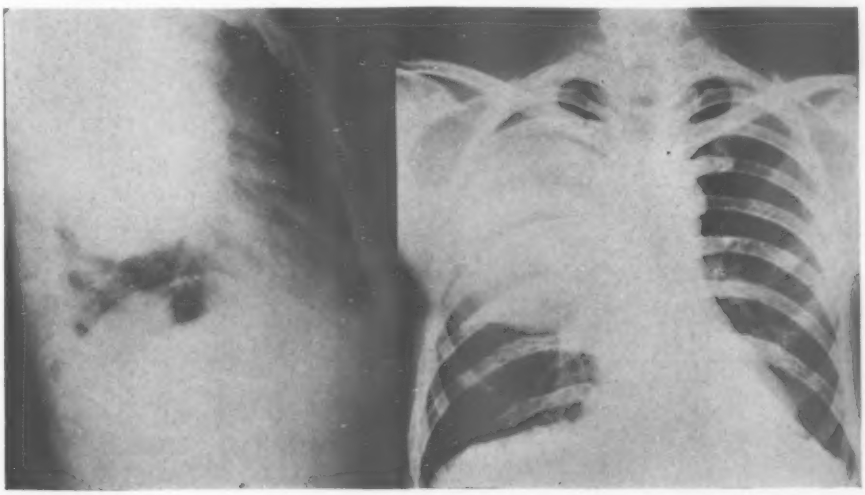

Fig. 2. A circumscribed primary epidermoid carcinoma of the right upper lobe in a white male, aged forty-four.

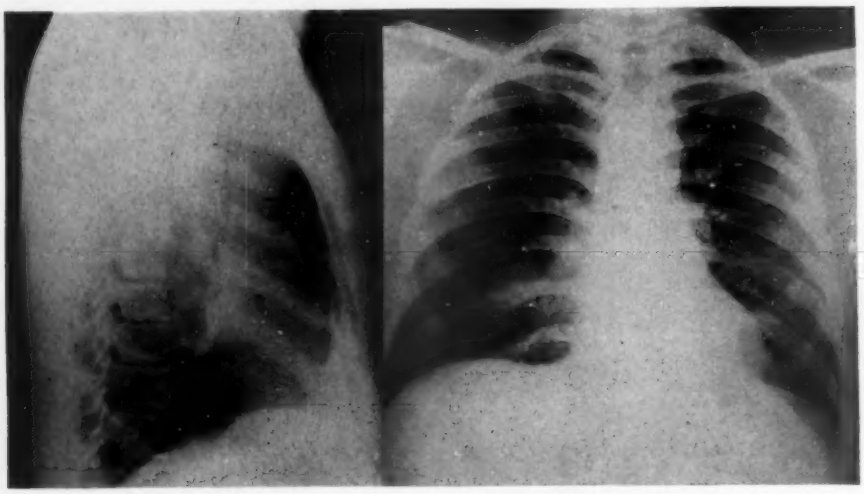

FIG. 3. Carcinoma originating in the secondary bronchi of the right middle lobe.

Figure 1 is a diagram of the normal anatomy of the lungs demonstrating the four lobe concept of the lung anatomy. On the right, the upper and middle and lower lobes are illustrated and the fourth lobe is shown as the apex of the lower lobe. Since the apices of the lower lobes have a separate bronchus and are often the seat of pulmonary carcinoma, their distinction as a fourth lobe is justified. The lingula of the left upper lobe corresponds to the middle lobe on the right.

The accompanying reproductions of roentgenograms illustrate the findings when the bronchi to the various lobes are the site of carcinoma.

Figures 2 and 3 represent 2 cases of the peripheral type. These are involvements of

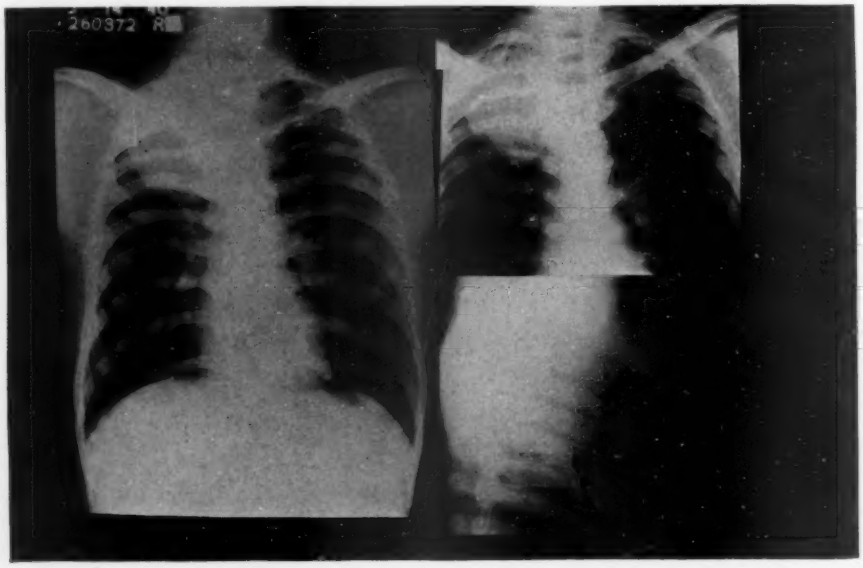

FIG. 4. A superior sulcus type of epidermoid carcinoma in a male, aged thirty-four. This patient complained of shoulder and back pain and presented a Horner's syndrome.

one or more segments of a lobe caused by carcinoma originating in an intermediate bronchus.

Figure 4 shows a superior sulcus type of carcinoma of the lung which has characteristically invaded the ribs.

Figure 5 is one of the two diffuse tumors of the series which proved to be primary cancer of the lung at postmortem examination.

Figures 6 to 11 inclusive show cancer in the various lobes producing atelectasis of the lung tissue distal to the involved bronchus.

The 3 cases which did not produce roentgen evidence of a pathological condition were very small interbronchial tumors discovered at postmortem in patients dying of another disease.

The course of the disease in this series is anything but encouraging for it has already claimed the lives of 93 per cent of its victims and there are 2 cases which have been lost to follow-up but are probably dead. Five of the patients are still living but 3 of these are relatively recent cases of which 2 have had thoracotomies which proved inoperable, and the third is in a home for incurables.

The average duration of life, for the patients who have died, was 245 days from the onset of the disease.

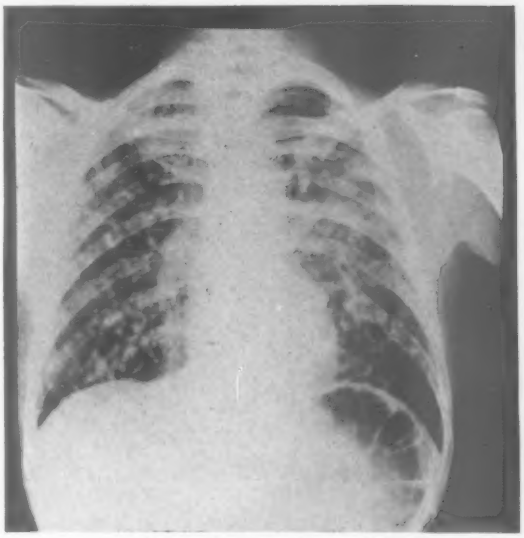

Fig. 5. Diffuse bilateral involvement of the lungs with carcinoma which at autopsy was proved to be primary in the lungs.

There are 2 cases who have had pneumonectomies and are alive and well three and four years after operation so they can be considered free of disease.

Table VIII presents the distribution of metastases in the 62 autopsied cases.

The regional lymph nodes were involved most often by metastases but the other common sites were the pleura, bone and brain.

There were 7 cases which had no metastases at postmortem; these included 3 small interbronchial lesions which were incidental autopsy findings in patients dying of other causes. The remaining 4 cases without metastases were patients with peripheral carcinomas. It is noticeable that Rabin and Neuhof[3] found the parenchymal carcinomas more apt to be circumscribed and slower to metastasize, for the only cases which had reached an appreciable size and had not spread elsewhere were of the peripheral type.

In this series the only treatment of carcinoma of the lung that could be considered curative was pneumonectomy, but roent-

Table VIII

METASTASES

Of the 62 autopsied cases	40 complete	
	16 all except head	
	6 limited to chest	
No metastases		7
Bronchial nodes		30
Mediastinal nodes		29
Pleural metastasis		22
Bone		20
Adrenal		18
Retroperitoneal nodes		16
Liver		14
Brain (40 cases)		11
Kidney		10
Cervical nodes		7
Heart		5
Esophagus		4
Spleen		4
Lung		4

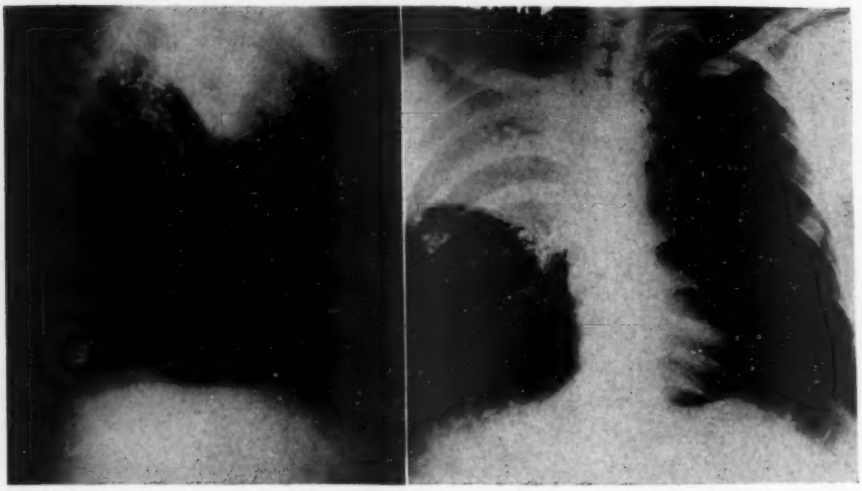

FIG. 6. Atelectasis of the right upper lobe secondary to a carcinoma obstructing the bronchus.

gen therapy was resorted to in 34 cases with apparent symptomatic benefit in 10 of these. The blocked bronchus was opened allowing aeration and drainage of the atelectatic and secondarily infected lobe. The average duration of life after the first symptoms in the cases treated with roentgen irradiation was 310 days, or sixty-five days longer than for those for the entire group (see Table IX).

TABLE IX

ROENTGEN THERAPY

Cases treated	34
Expected course not altered	24
Benefited	10
Average duration of life in cases receiving radiation therapy	10¼ mo.

The pathological classification is that submitted by Dr. Dan McEndy of the Department of Pathology at New York Hospital who reviewed and classified all the tissue examined at autopsy. His classification is similar to that used by Jenkinson

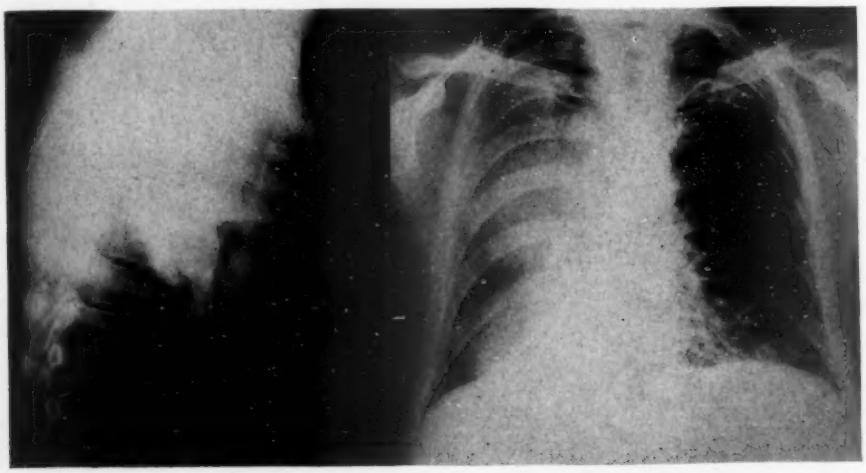

FIG. 7. Primary carcinoma of the left upper lobe bronchus producing atelectasis of the left upper lobe. The tumor mass can be seen at the apex of the atelectatic portion of the lung.

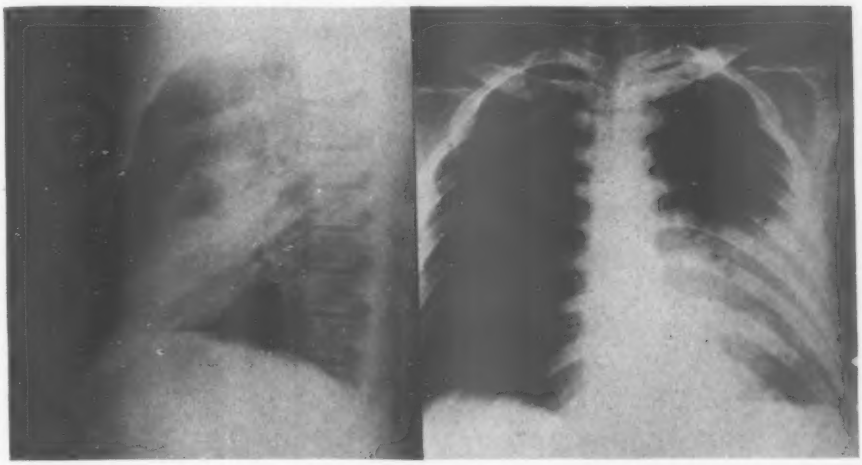

Fig. 8. Carcinoma obstructing the bronchus of the lingula of the left upper lobe. Note the atelectasis of the lingula of the left upper lobe.

and Hunter.[4] The tumors are divided into three major groups, as follows:

1. Epidermoid or squamous carcinoma which includes only those cases in which obvious keratin and/or epithelial pearls are present.

2. Adenocarcinoma—those which form acini and/or produce mucin.

3. Undifferentiated—which includes the typical forms such as "small cell carcinoma" of the oat cell type as well as those which show some differentiation but not enough to place them in a specific category of epidermoid or adenocarcinoma.

Table X

MICROSCOPIC PATHOLOGICAL CLASSIFICATION

Epidermoid carcinoma	50%
Adenocarcinoma	18%
Undifferentiated	32%

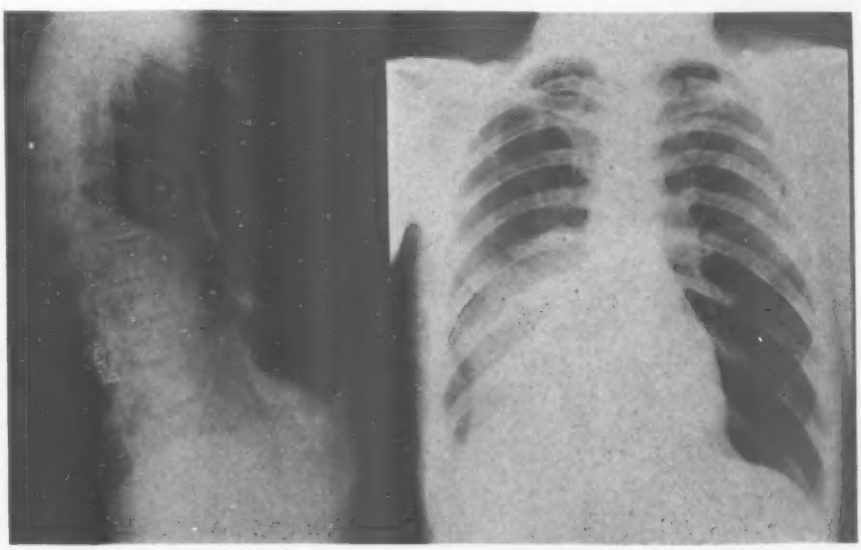

Fig. 9. Epidermoid carcinoma of the right lower lobe bronchus producing a typical atelectasis of the lobe it supplies.

FIG. 10. Carcinoma of left lower lobe bronchus producing atelectasis of the entire left lower lobe with shifting of the mediastinum toward the affected side.

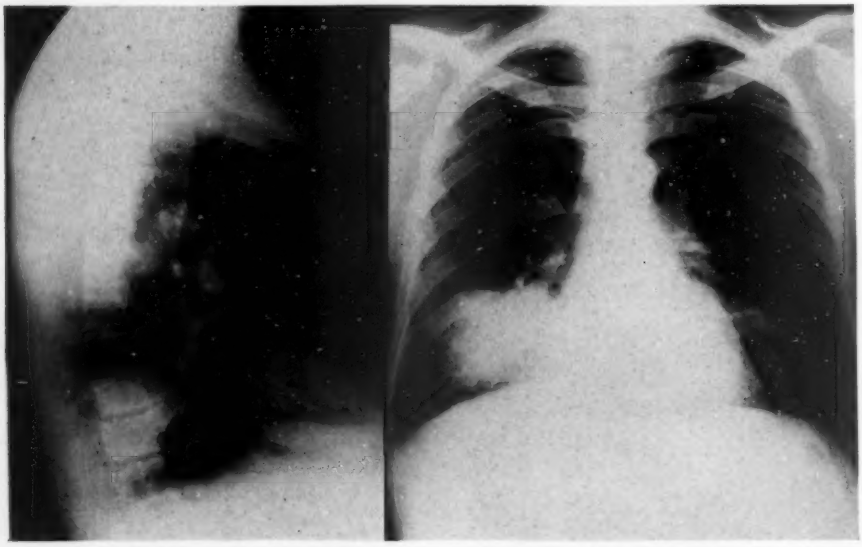

FIG. 11. A peripheral carcinoma of the right lower lobe in a white male, aged sixty-four. The patient is well four years after a pneumonectomy.

As shown in Table x, in this series 50 per cent were of the epidermoid type, 18 per cent were adenocarcinomas including 2 mucous gland carcinomas. The remaining 32 per cent were placed in the undifferentiated group.

CONCLUSIONS

1. Bronchogenic cancer is a major problem far more serious than is generally appreciated.

2. Every effort should be made to establish the exact diagnosis by procurement of tissue for histological examination.

3. The problem, as in all malignant disease, is early diagnosis. Fifty per cent of the cases we see should be subjected to surgery and this surgery should be extremely radi-

cal with no effort made to hold down the surgical mortality at the expense of radical curative surgical procedures.

4. The clinician who sees patients with symptoms referable to the chest should use the roentgenologist, bronchoscopist and surgeon early and urge radical surgery on the patient.

We are indebted to Dr. Dan Tucker who assisted us with the review of these cases and presented the outline of our work to the Research Society of New York Hospital; to Dr. N. C. Foote and Dr. Dudley Blossom* of the Department of Surgical Pathology of New York Hospital for reviewing the microscopic pathology of this series.

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THE ROENTGEN VISUALIZATION OF TUMORS OF THE CARDIA

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PROMINENT among the gastric lesions which elude early diagnosis is cancer of the cardiac end of the stomach. Its presence is frequently unsuspected both by the clinician and by the roentgenologist, and unless carefully sought for in each gastric study may pass undiagnosed only to be identified some time later when dysphagia, cardiospasm, and other significant signs and symptoms appear. Many of us have had the embarrassing experience of demonstrating a tumor of the cardia on roentgenograms previously reported as negative. The demonstration of a large filling defect in the upper portion of the stomach, esophageal obstruction, or rigidity of the lesser curvature superiorly readily serves to establish the diagnosis, but we have always felt it desirable to develop a method for earlier and more definite identification of these growths.

Stewart and Illick[1] advise close observation of the first swallow of barium as the stream enters the stomach. They describe several findings indicative of cancer at the cardia including dilatation or other evidence of esophageal obstruction, distortion of the rugal pattern, deformity of the gas bubble and occasionally the shadow of a soft tissue mass in it. Kirklin[2] justly stresses the identification of a tumor mass in the gas bubble of the empty or partially filled stomach, and cautions against relying on roentgenograms of the completely filled stomach or roentgenograms made with the patient in the Trendelenburg position. The use of Seidlitz powders better to visualize the cardia has its advocates.

Before the ingestion of a liquid barium mixture, the normal gas bubble is half moon in shape and varies considerably from time to time in the same individual. The base, formed by fluid in the stomach, may measure from 4 to 10 cm. in length, and its average height varies from 3 to 8 cm. The upper rim lies adjacent to the left leaf of the diaphragm, and the inner inferior angle is in close proximity to the mesial left diaphragmatic crus. The fluid level is usually at or slightly above the cardio-esophageal orifice. In some patients the gas-filled splenic flexure lies lateral and occasionally anterolateral to the bubble. Infrequently the splenic flexure is interposed between the diaphragm and the stomach bubble. Occasionally the latter is unusually large, as may occur with aerophagia. We have on occasion noted a considerable amount of gas in the stomach on six hour roentgenograms taken with the patient in the prone position, sometimes sufficient to outline a tumor mass in the cardia. The stomach beneath the gas bubble cannot be identified on direct studies of the abdomen, as a rule, because the gastric walls and contents present a roentgenographic density indistinguishable from the surrounding soft tissues.

Obviously the most reliable index for the correct diagnosis of tumors of the cardia is a clear demonstration of the tumor mass itself. Sometimes the existing stomach bubble is sufficient for this purpose. At other times, when there is insufficient gas to be of value, an adequate bubble can be created by air insufflation. This technique has already been applied to roentgen examination of the colon, bladder, and brain, so that the air contrast enemas, cysto-aerograms and pneumo-encephalograms have a well established position in diagnostic roentgenology.

In selected cases we have been able to produce contrast roentgenograms of the cardia by inflating the stomach through a Levin tube under roentgenoscopic control, using the hand bulb from a blood pressure apparatus. The amount of air necessary varies considerably, depending on the size of the cardia and the degree of distention desired. The insufflation may be made with the stomach empty or partially filled with

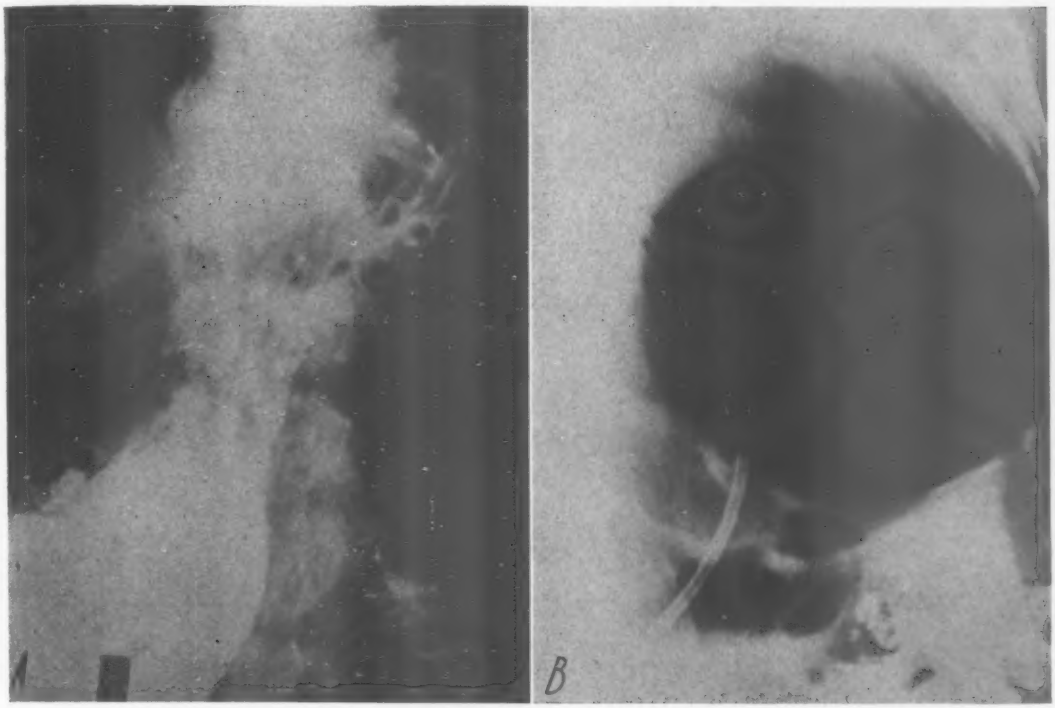

Fig. 1. Case 1. *A*, defect from spinal pressure in the mesial aspect of the cardia, with apparent luminal encroachment simulating tumor. *B*, same as *A* after insufflation of the cardia, revealing the latter to be normal.

barium. In suspicious cases the patient first is given a teaspoonful of thick barium paste, followed by 6 ounces of a liquid barium mixture. After roentgenoscopic study, roentgenograms are made with the patient in the erect and supine positions in the posteroanterior, oblique and lateral projections as indicated by the preceding roentgenoscopy. Roentgenograms made with a technique slightly less penetrating than the usual gastric exposure may demonstrate tumors otherwise overlooked.

The examination, which is adaptable to both office and hospital practice, can be performed rapidly and with a minimum of discomfort to the patient. We have encountered no untoward reactions from the air insufflations. This method is of special value for detecting masses beneath and extending slightly above the fluid level of the stomach bubble and in examining patients with cascade stomachs.

Precautions should be taken to avoid interpreting extraneous shadows as intrinsic gastric masses. Among these are the shadows of an overlying spine, of an enlarged left ventricle, a high retroperitoneal tumor, an exudate in the left lumbar region, and, in rare instances, an aneurysm of the upper abdominal aorta. An enlarged left lobe of the liver may offer some difficulty, but can usually be identified by the smoothness of its borders, its lingual contour and its continuity with the main hepatic mass. A tumor is usually portrayed as an irregular lobulated mass or masses independent of the hepatic shadow.

Case reports are appended which have been selected to illustrate various diagnostic and technical points.

REPORT OF CASES

Case 1. S. S., male, aged sixty-seven, had epigastric cramps for fourteen months before admission, which were relieved somewhat with milk. Roentgenograms taken at the onset of his present illness were reported as negative. During the next six months he had successive faint-

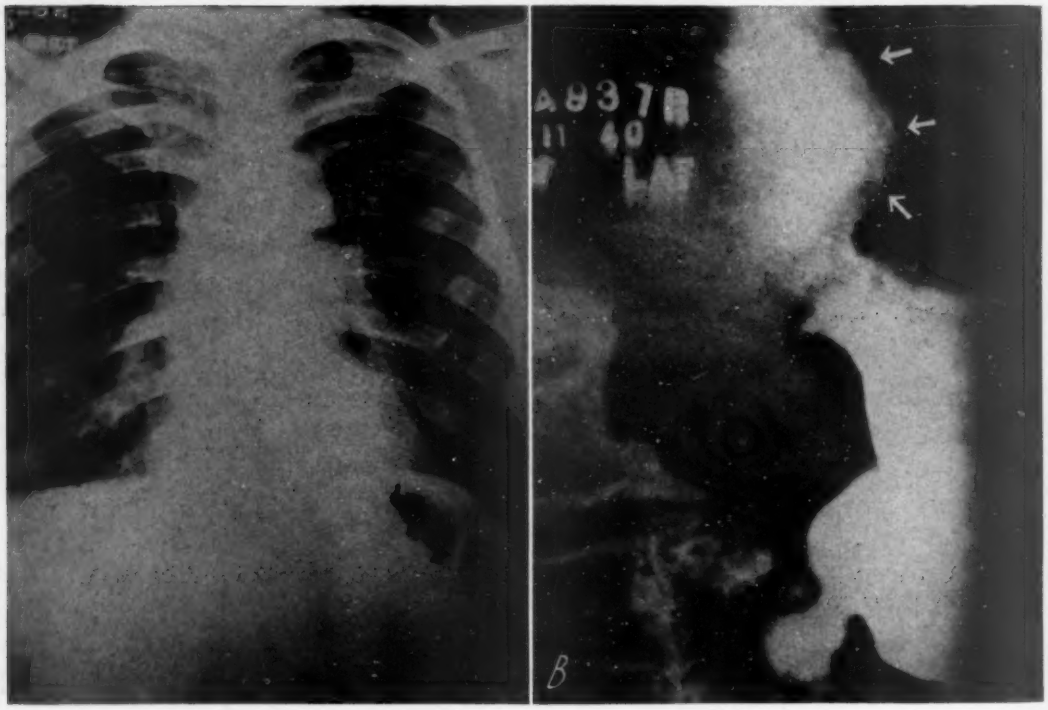

FIG. 2. Case II. *A*, nodular soft tissue shadow encroaching on the gastric lumen at the cardia suggesting hepatic border or tumor. *B*, tumor mass, proved carcinoma, suspected on the chest roentgenogram, *A*, and confirmed by gastric insufflation, lateral projection.

ing spells and a secondary anemia developed. There was no history of melena or hematemesis until one month before admission when he had a tarry stool. His hemoglobin fell from 95 to 55 per cent.

Examination revealed a pronounced pallor. There was the appearance of recent weight loss. His liver, smooth and not tender, was palpated three fingersbreadth beneath the costal margin. There were no palpable abdominal masses. The clinical diagnosis was cancer of the stomach, duodenal ulcer to be ruled out.

Routine roentgenograms revealed a persistent duodenal defect indicative of an ulcer. On the roentgenograms there was incomplete filling of the mesial portion of the cardia suggestive of tumefaction. After air inflation this observation was not confirmed, and the cardia was reported as normal (Fig. 1*A* and *B*).

The patient improved under symptomatic treatment.

Comment. The defect in the cardia on the routine roentgenograms was caused by spinal pressure. The upper half of the stomach was displaced toward the midline and was somewhat narrowed by a redundant splenic flexure. After air insufflation it was apparent that the cardia was normal. In view of the symptomatology and the patient's age, it was essential to rule out the cardia as the site of a malignant tumor.

CASE II. A. K., male, aged sixty-six, was treated intermittently for a peptic ulcer for the past nine years. He felt well under dietary treatment until three months ago when he developed anorexia, weakness and loss in weight of 20 pounds. Before admission, for a two weeks' period, he had had epigastric pain both before and after eating. There was no dysphagia. No positive findings were noted on physical examination. The clinical diagnosis was cancer of the stomach.

A teleroentgenogram of the chest revealed a mass, indistinguishable from the hepatic border, protruding into the stomach gas bubble. Roentgenographic study of the stomach showed free passage of barium through the cardio-esophageal orifice. There appeared to be a lat-

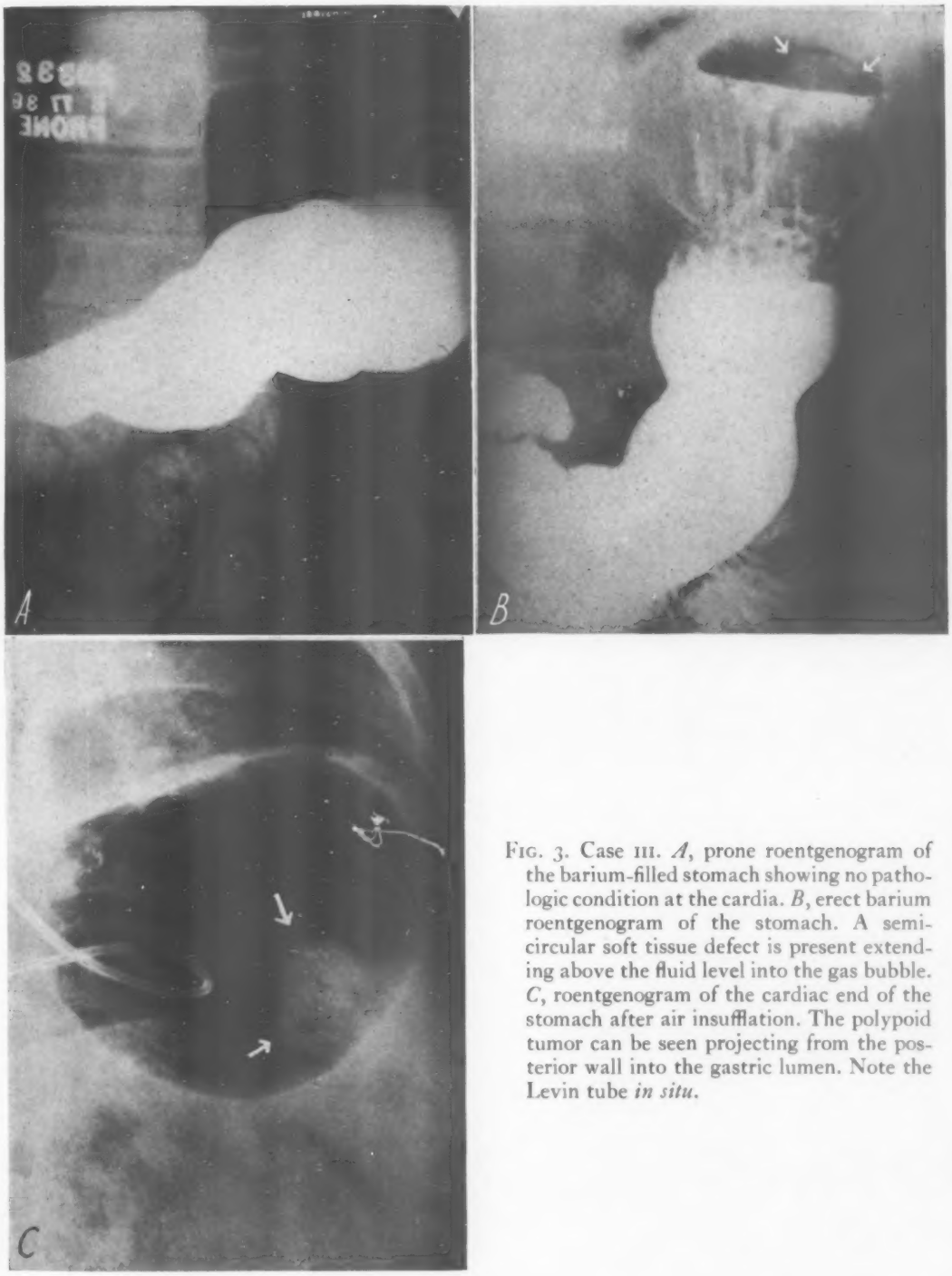

FIG. 3. Case III. *A*, prone roentgenogram of the barium-filled stomach showing no pathologic condition at the cardia. *B*, erect barium roentgenogram of the stomach. A semicircular soft tissue defect is present extending above the fluid level into the gas bubble. *C*, roentgenogram of the cardiac end of the stomach after air insufflation. The polypoid tumor can be seen projecting from the posterior wall into the gastric lumen. Note the Levin tube *in situ*.

eral displacement of the barium stream as it entered the stomach. Roentgenograms, by direct study of the barium filled stomach, were normal. After inflation with air, a mass was portrayed as a positive shadow against the radiotransparent air. It was best seen on the roentgenograms taken with less penetration than is usually employed (Fig. 2, *A* and *B*).

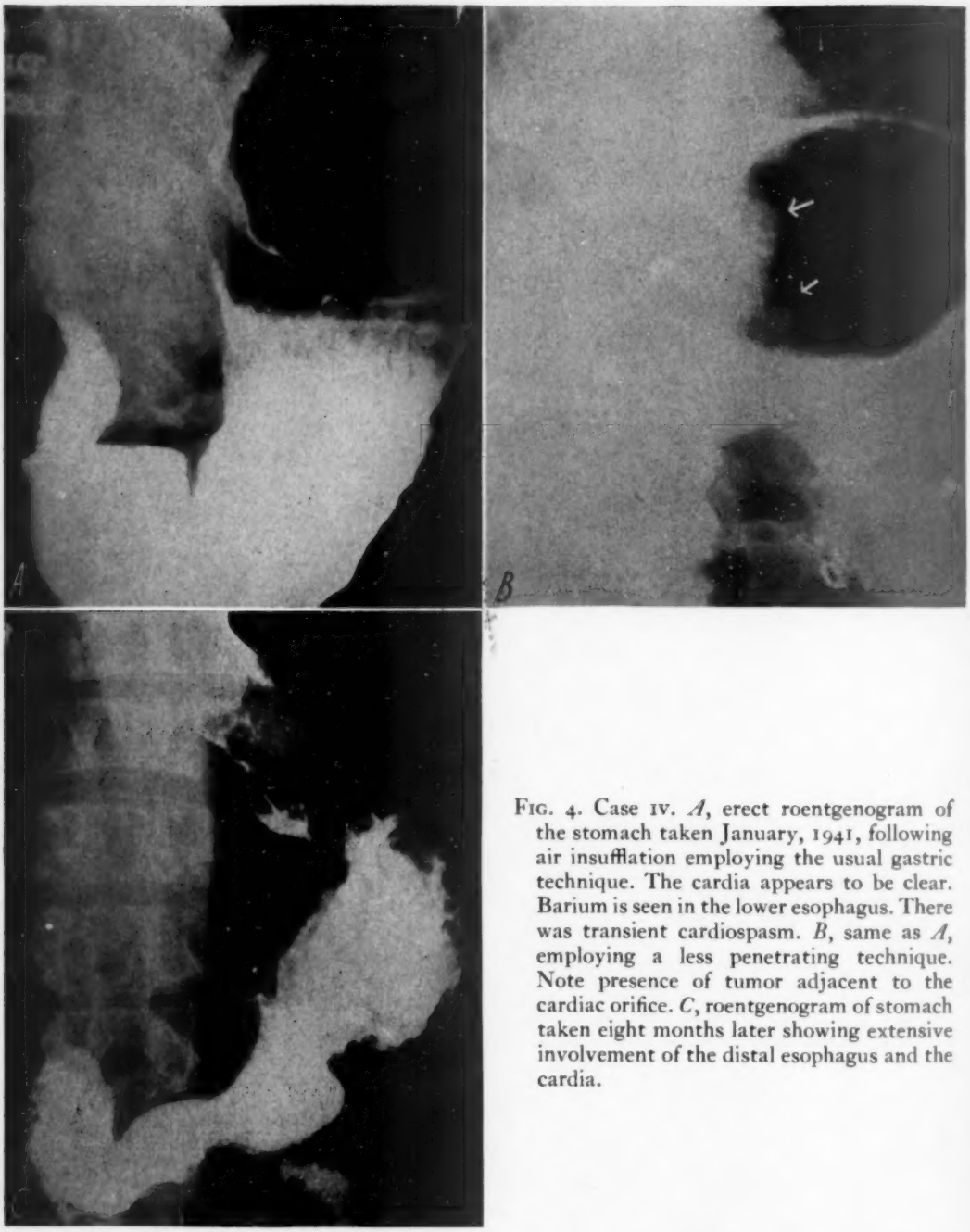

Fig. 4. Case iv. *A*, erect roentgenogram of the stomach taken January, 1941, following air insufflation employing the usual gastric technique. The cardia appears to be clear. Barium is seen in the lower esophagus. There was transient cardiospasm. *B*, same as *A*, employing a less penetrating technique. Note presence of tumor adjacent to the cardiac orifice. *C*, roentgenogram of stomach taken eight months later showing extensive involvement of the distal esophagus and the cardia.

Gastroscopy showed a nodular smooth mass at the cardia. At operation a large inoperable cancer was found encircling the cardia and extending into the diaphragm. Liver metastases were present.

Comment. The diagnosis was suspected on the chest roentgenogram because the stomach bubble happened to be present and the exposure made with sufficient penetration to visualize a soft tissue irregularity. The diagnosis was confirmed by subsequent roentgenograms using the technique of air insufflation to delineate the tumor mass more clearly.

Case III. M. P., male, aged sixty-six, complained of epigastric distress for five years before his admission to the hospital in 1939. Eight weeks before, he had had hematemesis for a twenty-four hour period, followed by tarry stools. This was followed by a pronounced initial weight loss which, however, was soon regained. There was no dysphagia or other subjective complaint. Objectively the examination was negative.

Roentgenograms of the stomach, taken with the patient in the erect position, revealed a semilunate, soft tissue shadow suggestive of a mass protruding into the cardia of the stomach from its posterior wall. Roentgenograms taken in the prone and Trendelenburg positions were negative. Following air insufflation a polypoid tumor mass, about 3 cm. in diameter, protruding into the cardia from a broad base was demonstrated (Fig. 3, *A*, *B* and *C*).

Gastroscopic examination revealed a sessile polyp attached to the posterior wall near the greater curvature. The adjacent walls were pliable, with no evidence of infiltration. The overlying mucosa was irregular, glistening and intact.

On July 17, 1940, the patient was again gastroscoped with similar findings. His condition remained excellent until November, 1940, when another painless hemorrhage occurred. He was again gastroscoped early in 1941 with no change in the findings. On April, 1942, an ulcerated area, covered with a grayish exudate, about 3 cm. in diameter, was seen over the center of the polyp. This apparently healed spontaneously since a subsequent gastroscopy in July, 1942, revealed intact mucosa.

Comment. In this instance the polyp could not be diagnosed on the roentgenograms taken in the prone position, and its presence could only be suspected on the erect studies. The air contrast roentgenograms of the stomach portrayed the lesion with such clarity that there was no doubt concerning the presence of a mass and the nature of its attachment.

Case IV. M. W., male, aged sixty-one, complained of difficulty in swallowing, weight loss and weakness for three months beginning in January, 1941. Esophagoscopy revealed an irregular beefy-red indurated lesion at the cardiac end of the esophagus. A biopsy specimen was reported as leukoplakia. He was readmitted eight months later with epigastric pain associated with swallowing, increased dysphagia, and vomiting after meals. There had been progressive loss of weight. No significant findings were noted on physical examination.

Roentgenologic examination of the esophagus and stomach at his first admission in January, 1941, revealed some difficulty in the passage of barium at the cardio-esophageal junction. Transient dilatation of the esophagus was present. In view of the suspicion of a neoplasm at the cardia, an air insufflation was performed. On the roentgenograms taken with normal roentgenographic density, the cardia appeared to be normal. However, on roentgenograms made with less penetration it was possible to demonstrate an infiltrating lesion along the lesser curvature extending beyond the cardio-esophageal junction into the cardia. Re-examination in September, 1941, revealed an extensive tumor involving the distal third of the esophagus and a large portion of the cardia (Fig. 4, *A*, *B* and *C*).

At operation a large, firm, fungating mass was found involving the upper portion of the lesser curvature, cardiac orifice, and esophagus. Metastatic lymph nodes were present in the gastrohepatic omentum. A gastrostomy was performed.

Comment. When first seen the lesion was not too dense nor prominent, and might easily have been overlooked on the routine insufflation roentgenograms as it was on the routine roentgenograms if soft tissue technique had not been used.

Case V. B. R., female, aged fifty-six, swallowed a fragment of bone six months before admission. Fever followed soon thereafter, with pain in the upper chest and neck. An abscess developed which ruptured into the upper esophagus; relief followed. Two weeks later she complained of nausea, epigastric pain and dysphagia. During the following four months there was a loss in weight of 20 pounds. When admitted she could swallow only liquids.

Roentgenologic examination of the esophagus revealed free passage of barium through the cardio-esophageal junction. No evidence of dilatation was present. However, a soft tissue mass was seen protruding into the gas bubble, more clearly demonstrated by air insufflation (Fig. 5).

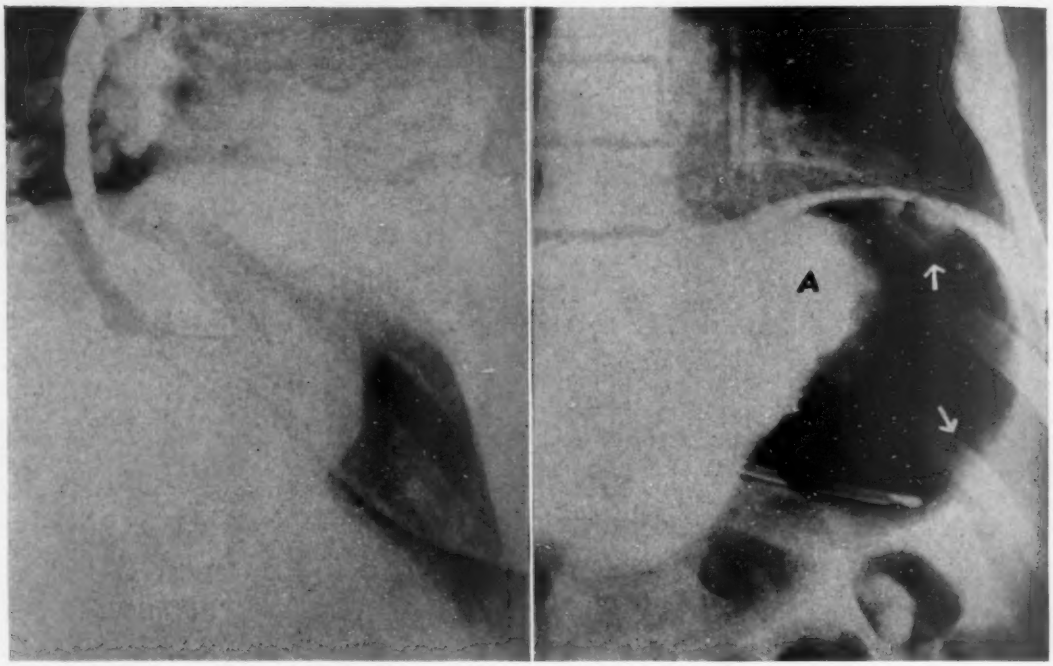

Fig. 5. Case v. Right oblique view of the cardia after air insufflation revealing a large soft tissue mass adjacent to but not involving the cardiac orifice. No evidence of cardiospasm. The esophagus is outlined with barium paste.

Fig. 6. Case vi. Gastric insufflation revealing a large tumor mass (carcinoma) of the cardia, with a secondary deposit on the dome of the stomach, and one on the greater curvature just beyond the tip of the Levin tube.

Gastroscopy showed a firm irregular mass at the cardia. At operation a firm, irregular, slightly nodular tumor, about the size of a lemon, was found apparently arising from the right posterolateral wall of the stomach at the cardio-esophageal opening. The remainder of the stomach was slightly smaller than usual, but was otherwise normal. The liver contained a metastatic nodule, 2 cm. in diameter, on the anterosuperior aspect of the right lobe.

Comment. In this instance the neoplasm of the cardia did not involve the cardio-esophageal opening. Although the patient complained of dysphagia, there were no roentgenologic evidences of esophageal obstruction. The diagnosis was suspected from the roentgenoscopic findings and was confirmed by the air contrast studies.

Case vi. E. B., male, aged sixty-two, complained of weakness for four years before admission. A diagnosis of secondary anemia was made during this period, and he responded well to a series of liver and iron injections. He was able to continue his work as a painter until one year ago. At that time there was a recurrence of weakness. He developed a marked pallor, lost 30 pounds in weight in the five months prior to admission, and one month ago spit a teaspoonful of bright red blood. There were no gastrointestinal symptoms, and his appetite remained excellent. Physical examination revealed a Virchow's node in the left supraclavicular area. There was no other adenopathy. The spleen was not palpable. The liver was moderately enlarged. Gastric extraction revealed fresh blood on several occasions, and an achlorhydria. Hemoglobin was 40 per cent.

Roentgenograms of the stomach revealed a large filling defect in the cardia. Gastric insufflation portrayed the tumor with better detail, and demonstrated a daughter nodule at the dome of the cardia and another on the greater curvature opposite and slightly below the primary growth. Roentgenographic examination of the chest showed a metastatic deposit in the axillary portion of the left eighth rib (Fig. 6).

Comment. Although there was little doubt of the correct diagnosis from the routine roentgenograms, those made after air insufflation outlined the tumor more clearly and revealed in addition the presence of two secondary growths.

SUMMARY

The positive roentgenologic diagnosis of cancer of the cardia of the stomach may depend on visualization of the tumor mass itself. At times this may be accomplished by demonstrating the tumor through the existing gas in the stomach. In other instances the diagnosis may be made by creating a large gas bubble by insufflating air into the stomach through a Levin tube. The technique is described and illustrative cases are reported.

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PARTIAL PARALYSIS OF A HEMIDIAPHRAGM*

By HANS ABELES *and* GEORGE C. LEINER
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THE motor innervation of the diaphragm is essentially provided by the phrenic nerve. Many authors (Russell,[7] Schlaepfer[8,9]) believe that the phrenic is the only motor nerve of the diaphragm, others (Cavalié,[1] Felix[2]) assume that the intercostal nerves furnish motor branches, too. Also the sympathetic nerves and the vagus may, according to some investigators (Kuré and Shimbo,[4] Felix,[2] Cavalié[1]) participate in the motor innervation of the diaphragm.

Damage to a phrenic nerve resulting in paralysis of a hemidiaphragm is not infrequent. It occurs in injuries and diseases of the cervical cord; in injuries to and operations of the phrenic nerve; in tumors in the region of the neck and the mediastinum and in neuritis. Paralysis of the diaphragm can also be caused by disease of its muscle.

Partial paralysis of a hemidiaphragm, however, is apparently very rare. Hitzenberger[3] reports such a case:

A female patient with cerebrospinal lues had among other symptoms a paresis of her right arm. On roentgenoscopy in the posteroanterior view, the medial portion of the right diaphragm was elevated. In the lateral view its anterior portion appeared elevated. The right diaphragm moved poorly and showed lagging. On sniffing, the medial part moved paradoxically. The lateral and posterior portions of the right diaphragm and the left diaphragm were normal. Hitzenberger believes that that part of the phrenic nerve was damaged which supplies the medial and anterior part of the diaphragm and that such an injury is possible only in the nuclear part of the nerve. Russell[7] found in the macacus that on stimulation of the fourth cervical nerve root the medial part of the diaphragm contracted; the outermost portion of the diaphragm contracted when the sixth root was excited; the intermediate portion, when the fifth root was stimulated.

On routine roentgenologic examination a partial paralysis of a diaphragm was discovered accidentally.

A man, aged twenty-nine, had had an anterior poliomyelitis at the age of eleven. All extremities had been involved. He had recovered nearly completely and was able to do any kind of work and sport without difficulty.

On physical examination there was a marked scoliosis of the thoracic spine to the left with marked kyphosis and compensatory lordosis of the lower thoracic and lumbar spine. The neurologic examination (Dr. Leo Spiegel) revealed the following abnormal findings: The volume of the left upper extremity is somewhat diminished compared with the right. The volume of the right lower extremity is somewhat diminished compared with the left. The muscle power in the left upper extremity is diminished. Deep reflexes are practically absent except for an occasional right ankle jerk and a questionable radial reflex bilaterally. The sternocleidomastoid muscle on the left is thinner than the one on the right. Summary: The patient presents a picture compatible with an old anterior poliomyelitis. The brunt of the lesion appears to have been in the cervical cord, predominantly on the left side. There is also a milder involvement of the lower lumbar cord on the right side. An interesting feature is the practically complete areflexia despite the presence of apparently good nutrition in many of the muscles.

Roentgen examination (Fig. 1 and 2) and roentgenoscopy showed the following: There is marked scoliosis in the midportion of the thoracic spine, with the convexity towards the left. The left diaphragm is normal and shows good excursion. The central two-thirds of the right diaphragm is markedly elevated and moves only slightly with respiration and paradoxically on sniffing. The lateral and posterior part of the right diaphragm moves more freely. The heart is normal in size and shape.

Spirometric studies revealed considerable functional damage. The vital capacity was

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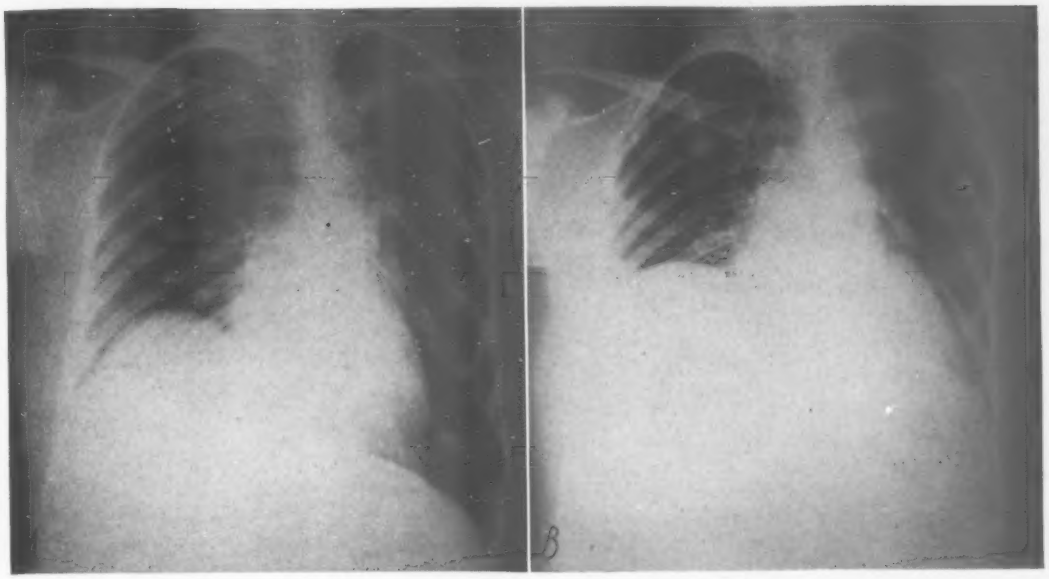

Fig. 1. Posteroanterior view. *A*, inspiration; *B*, expiration. The left diaphragm shows good excursion. The central part of the right diaphragm is elevated and moves only slightly; the lateral part moves more freely.

2,400 cc., that is 60 per cent of normal. The maximum breathing capacity was 53 liters (normally 100 liters or more). The maximum breathing capacity divided through the minute volume of respiration was 8.9 (normally 10 to 15). The oxygen debt after exercise was normal. How much of the reduction in pulmonary volume and function can be attributed to the paralysis of the diaphragm and how much of it is caused by the kyphoscoliosis cannot be decided. The scoliosis of the spine to the other side is a frequent occurrence in paralysis of a diaphragm. In this case it may have been caused also by weakening of other muscles.

How can it be explained that the right diaphragm is partly paralyzed whereas the neurological examination reveals that the left side of the cervical cord seems to be affected more than the right side? Crossing of the phrenic nerves might be the reason. Rosenblueth and Ortiz[6] and Rosenblueth, Klopp and Simeone[5] were able to prove in animals of several species the presence of a crossing of the phrenic in the spinal cord. The partial paralysis, as mentioned above in Hitzenberger's case, is probably due to damage to the nuclear region of that portion of the phrenic which supplies the anterior and medial region.

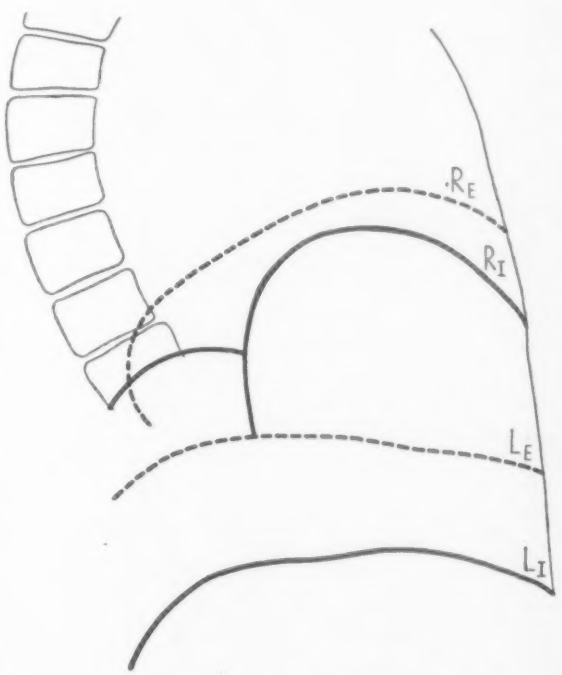

Fig. 2. Right lateral view. Diagram traced from roentgenogram. R_I, R_E, right diaphragm in inspiratory and expiratory position; L_I, L_E, left diaphragm in inspiratory and expiratory position. The left diaphragm shows good excursion. The right diaphragm is elevated; its anterior part moves only slightly; the posterior part moves more freely.

SUMMARY

A man was seen in whom a paralysis of the medial and anterior portion of the right hemidiaphragm was present as a remainder of an old anterior poliomyelitis. Scoliosis to the contralateral side and considerable functional damage were found.

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THE ROENTGENOLOGICAL CHANGES IN THE ESOPHAGUS IN TUBERCULOUS MEDIASTINITIS*

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THE differential diagnosis between mediastinal tumor and mediastinal infection is often difficult for the roentgenologist as well as for the clinician. The only roentgenographic change may be widening of the mediastinal shadow without parenchymal lung disease. Any distinctive roentgenological sign which would aid in proving one diagnosis or the other would be of great value. Recently, examination of the barium-filled esophagus in addition to the usual chest roentgenograms has given promise of furnishing considerable differential aid. Five patients, all with active adult mediastinal tuberculosis, were studied in this manner, and in each case the value of esophageal study was confirmed.

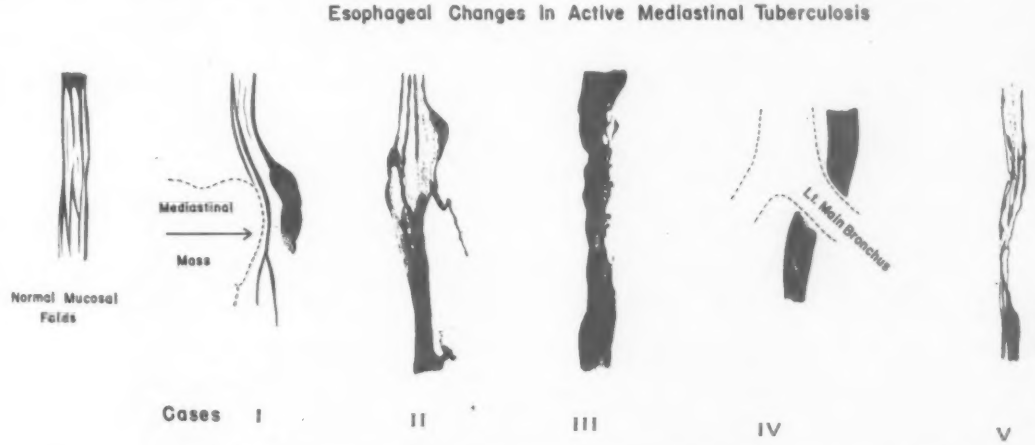

FIG. 1. Tracing of anteroposterior esophageal spot roentgenograms in Cases I, II, III, IV and V.

CASE REPORTS

CASE 1.† (U-270125) *Purulent Tuberculous Mediastinitis.* (Proved by postmortem.)

A male, aged seventy-two, engineer, had had malaise with frequent chills and fever to 100°F. for six weeks. He had gradually become drowsy and lethargic. He had lost 50 pounds in weight. No definite diagnosis had been established. nO admission he was acutely ill, drowsy, with a temperature of 100°F. and a leukocyte count of 18,600. The lungs contained a few basal râles and a patch of tubular breathing in the right scapular region. The spleen was enlarged.

Roentgenograms on admission showed a widened, slightly lobulated mediastinal shadow and partial collapse of the right middle lobe (Fig. 2). The barium-filled esophagus was displaced to the right above the aortic arch and to the left below it. The esophagus was flattened in the anteroposterior diameter, and the mucosal pattern at the junction of the middle and upper thirds was irregular. The spot roentgenograms were of poor quality, and the examination was incomplete due to the patient's poor cooperation.

He died on the sixth hospital day.

Postmortem Examination. A 5 cm. ulcer of the esophagus was found just below the level of the carina. The ulcer had raised soft and necrotic edges; its base was gray and necrotic. A perforation from the base of the ulcer extended anteriorly into several markedly enlarged lymph nodes which surrounded the trachea, bronchi and esophagus. These nodes were also soft,

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† Previously published as Case 26522, Case Records of the Massachusetts General Hospital. *New England J. Med.*, 1940, *223*, 1070–1073.

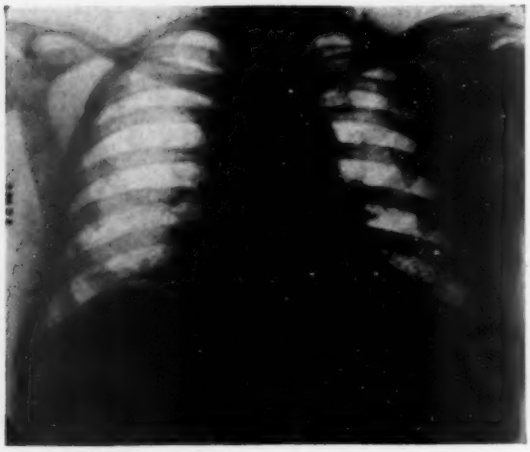

Fig. 2. Case 1. Purulent tuberculous mediastinitis. Widened mediastinal shadow and partial collapse of the right middle lobe.

gray and necrotic. The mediastinal tissues contained several small abscesses, and the septic process had extended through the fascial planes into the neck, with a small abscess at the lower pole of the thyroid gland. The gross anatomical diagnosis was carcinoma, but microscopic examination showed caseation, necrosis and typical tubercle formation with numerous tubercle bacilli. Tubercles were also present in the lungs, spleen and pericardium.

Comment. After six weeks of unexplained fever and chills, the patient showed mediastinal widening by roentgenogram. With this widening, the esophagus was flattened, displaced, and showed an irregular mucosal pattern. The clinical and roentgenological diagnoses were carcinoma. At postmortem examination, a tuberculous mediastinitis with ulceration into the esophagus was found.

Case 11. (U-336763) *Nonspecific Granulomatous and Caseating Mediastinitis.* (Proved by postmortem.)

In mid December, 1941, a boy, aged sixteen, developed headache, malaise and had a shaking chill. Shortly after this, a red papular and vesicular skin rash appeared and recurred several times. There was transient pain, redness and swelling of the knees.

On admission in January, 1942, the patient was pale with a multiform skin eruption. There was slight tenderness and swelling of both knees. His temperature ran between 100 and 102°F. Repeated leukocyte counts never rose

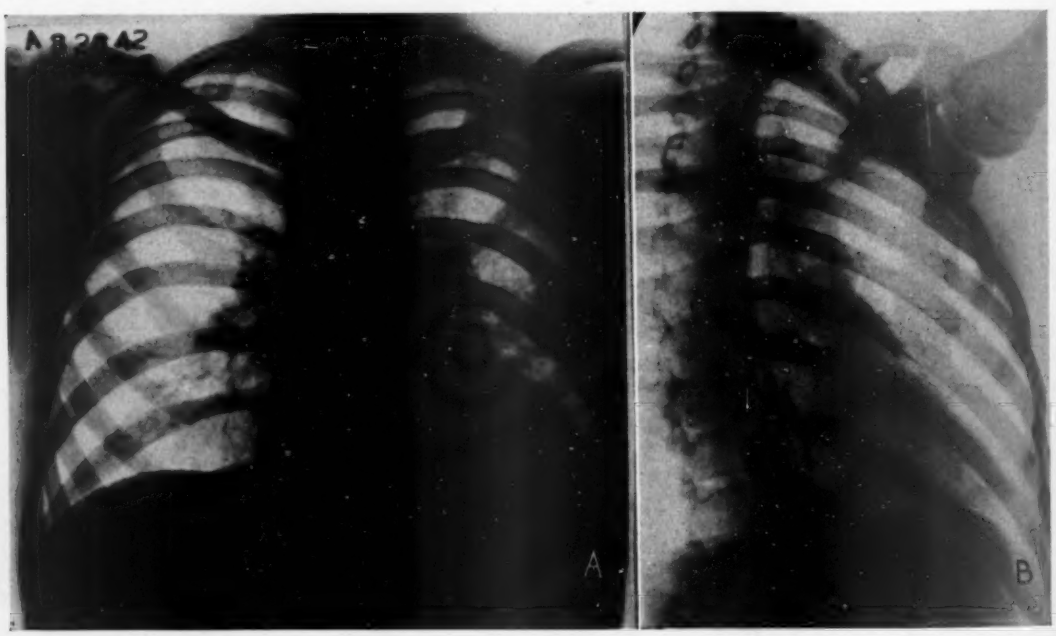

Fig. 3. Case 11. Nonspecific granulomatous and caseating mediastinitis. *A*, enlarged hilar lymph nodes and density in the left lower lobe. *B*, oblique view of the barium-filled esophagus. The lower third shows irregularity in width and numerous projections from the wall.

above 5,400. Several clinical diagnoses were suggested.

Roentgenograms of the chest were negative in January. On January 23 he complained for the first time of a dull pain in the right lower anterior chest, increased by swallowing and deep breathing. Two days later an unproductive cough developed. One month after admission, roentgenograms of the chest (Fig. 3*A*) showed for the first time enlarged hilar glands and slightly increased density in the left lower lobe. At this time he raised a small amount of blood-tinged sputum.

Barium examination of the esophagus (Fig. 3*B* and 4) March 19–20, 1942: In the lower barium-filled esophagus for a length of 7 cm. there was marked irregularity of the wall with several projections (arrows). The width of the lumen was irregular. Normal mucosal folds passed through this area (Fig. 4*A*). A short, angulated, barium-filled fistula was demonstrated (Fig. 4*B*). These changes were interpreted as signifying peri-esophageal infection.

On March 26, the left lower lobe became completely consolidated. Four months after the onset of his illness he had a sudden hemoptysis and died.

Postmortem Examination. The superior and posterior portions of the mediastinum were filled with greatly enlarged lymph nodes which were matted together. On section, they were both firm and caseous. A small sinus ran from a diverticulum of the esophagus into a mass 4 cm. in diameter beneath the carina. The diverticulum was 1 cm., the sinus 2–3 mm. in diameter. There was a questionable second sinus into the left main bronchus. Both upper lobes were consolidated and contained several gray tubercles. There was an acute fibrinous pleuritis. The periaortic and retroperitoneal lymph nodes were similar to those in the mediastinum. The microscropic as well as the gross appearance was typical of tuberculosis. No tubercle bacilli could be found, however. The final pathologic diagnosis was a "nonspecific granulomatous and caseating process."

Comment. After three months of unexplained fever with a gradual, retrogressive course, and one month after the onset of substernal pain, barium examination of the esophagus localized the infection to the mediastinum by demonstrating actual esophageal wall involvement. The roentgenographic changes were multiple adhesions to the esophageal wall, a short fistula into the mediastinum, and enlarged hilar shadows. Autopsy revealed a caseating and granulomatous mediastinitis and retroperitoneal adenitis.

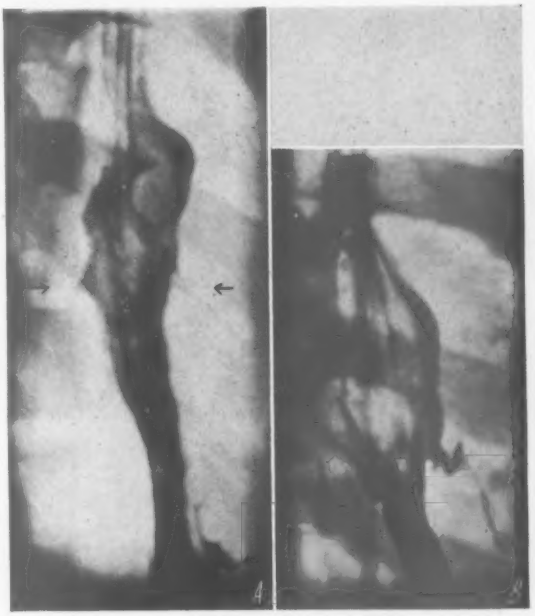

Fig. 4. Case II. Spot roentgenograms. *A*, note the points of attachment of adhesions to the wall (arrows). *B*, with less filling, a fistula is seen. The mucosal pattern in the widened area is irregular.

Case III.* (U-328726) *Tuberculous Bronchitis.* (Proved by biopsy.)

A male, aged thirty-seven, shoe-worker, suddenly became hoarse in February, 1941. In April, he developed a paroxysmal cough, productive of black and green colored sputum, and slight exertional dyspnea. In November, there was a sudden onset of dysphagia with solid foods. On admission in December, 1941 (ten months after the onset of symptoms), the left vocal cord was paralyzed and the trachea was shifted slightly to the right. The temperature was normal; the leukocyte count was 8,100. The lung fields were clear by physical and roentgenological examination. Roentgenograms of the chest demonstrated a mass in the upper mediastinum just superior to the arch of the aorta.

* Case III was previously published as Case 28201, Case Records of the Massachusetts General Hospital, *New England J. Med.*, 1942, *226*, 825–828.

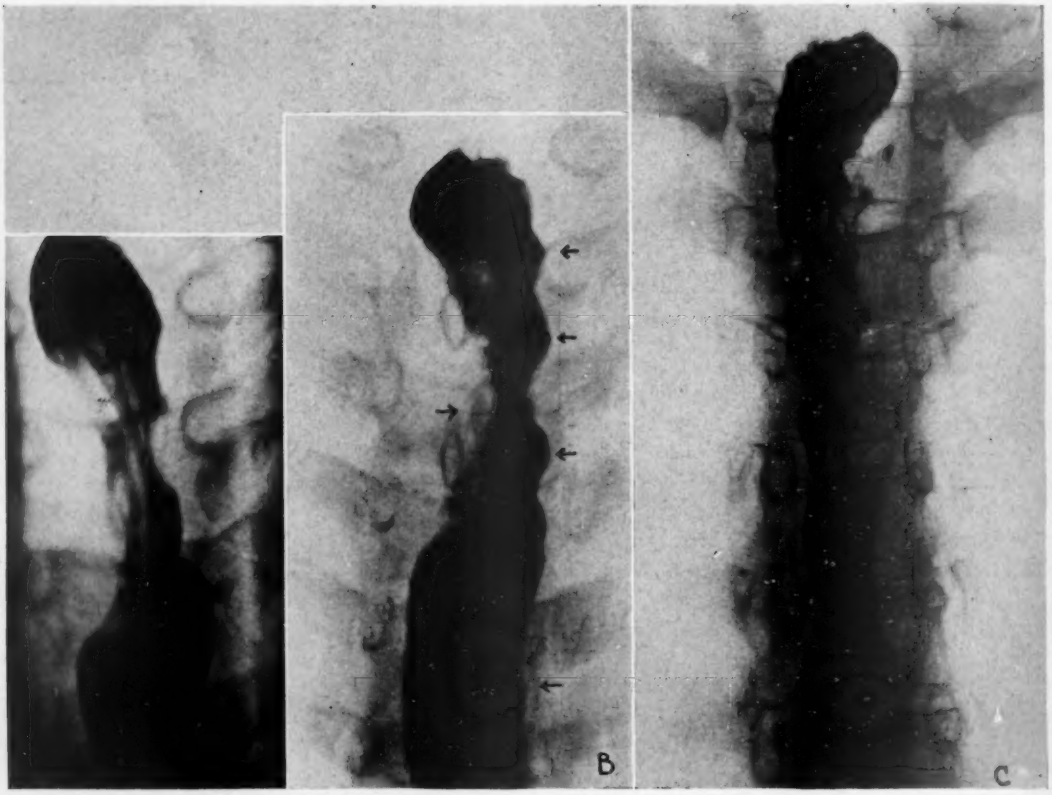

Fig. 5. Case III. Tuberculous bronchitis (spot roentgenograms). *A*, December 8, 1941. Narrowing of the esophagus with a large pressure defect from a mediastinal mass. *B*, January 1, 1942. Increase in length of the involved esophagus and numerous projections due to adhesions (arrows). *C*, April 26, 1942. Further extensions of the process and irregularity of the mucosal pattern.

A swallow of barium on December 8, 1941 (Fig. 5*A*), showed pressure on the esophagus from the mass in the upper mediastinum. The esophagus was narrowed over a length of 4 cm., most markedly in the anteroposterior diameter. The mucosa appeared destroyed. The roentgenological diagnosis was carcinoma. Three weeks later, the length of the involved segment had increased (Fig. 5*B*).

Bronchoscopy revealed an irregular reddening and outcropping of the left main bronchus, of the right upper lobe bronchus, and of the carina. Esophagoscopy showed no abnormality. The patient was given 1,200 roentgens at 200 kv. to the anterior and posterior mediastinum as a test dose for lymphoma; there was no change.

The first biopsy from the bronchial mucosa was reported as chronic inflammation; a second bronchial biopsy in February, 1942, showed tuberculosis.

In April, 1942 (Fig. 6), the lung fields were still clear, and the mass in the upper mediastinum had not changed in size; it was compressing the lower trachea. The length of the involved esophagus had again increased (Fig. 5*C*). The mucosal pattern was irregular and broken up. Several projections from the wall were seen on the spot roentgenograms and were interpreted as due to adhesions.

The patient was discharged to a tuberculosis sanatorium.

Comment. A proved case of tuberculous bronchitis without peripheral lung disease showed a mediastinal mass, with pressure on and adhesions to the esophagus in the region of the mass. The mucosal pattern was irregular in the involved segment, but direct visualization of the esophageal mucosa showed no abnormality. Figure 5 shows the gradual lengthening of the involved area over a period of five months.

Case iv. (U-27439) *Acute Tuberculous Adenitis.* (Proved by biopsy.) A woman, aged thirty-four, five weeks before admission had a chill, followed by several less severe chills. The temperature rose to 100 and 102° F. after each chill. There was mild pain in the knees. Examination in April, 1942, showed a pale woman with enlarged cervical and epitrochlear glands. The temperature remained between 100 and 101° F. for ten days, and then fell to normal. The leukocyte count ranged from 6,000 to 9,200.

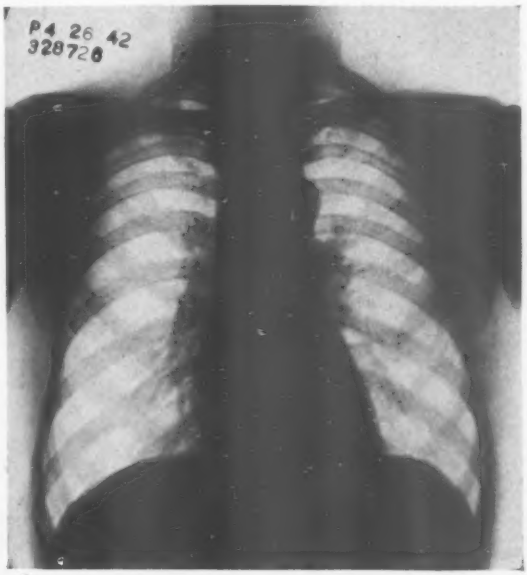

Fig. 6. Case iii. Tuberculous bronchitis. Enlargement of the left hilum. The lung fields are clear.

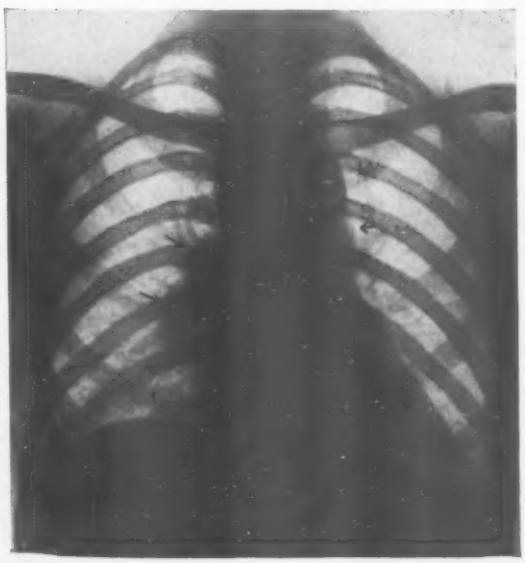

Fig. 7. Case iv. Active tuberculous adenitis. Enlarged hilar and mediastinal glands (arrows).

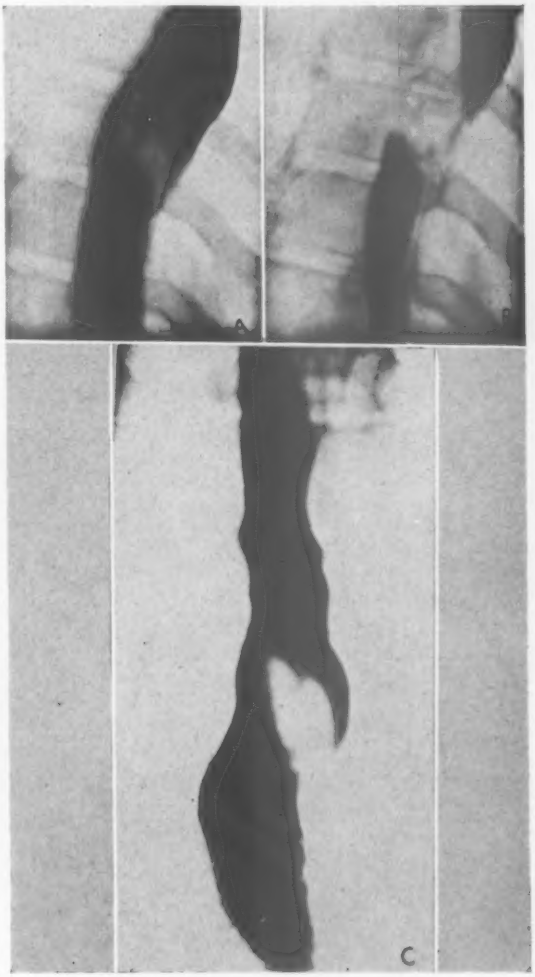

Fig. 8. Case iv. Active tuberculous adenitis (spot roentgenograms). *A*, oblique filling defect made by the left main bronchus. *B*, with less filling, the sharp edges of the pressure defect are brought out. *C*, six months later the esophagus showed in addition two small adhesions below the level of the bronchus.

Roentgenograms showed the mediastinal shadow enlarged to the right and to the left with enlarged hilar nodes (Fig. 7). Barium swallow—partial filling (Fig. 8*A*): At a point where the left main bronchus crosses anteriorly to the esophagus, the bronchus can be seen to produce an oblique, cylindrical pressure defect. With slightly less filling (Fig. 8*B*), the oblique superior and inferior borders of the pressure de-

fect are seen sharp and cleanly cut off. This was interpreted as indicating intimate adherence of the esophagus to the bronchus.

Biopsy of a left supraclavicular gland showed active tuberculosis.

The patient improved steadily on bed rest and was discharged home. Six months later she was fully active and had gained 4 pounds in weight. There was no palpable adenopathy. The mediastinal shadow was not enlarged. The barium-filled esophagus (Fig. 8*C*) showed the adherence to the bronchus and, in addition, below the bronchus two small, sharp, pointed projections. The lumen of the esophagus varied slightly in size for 3 inches below the crossing bronchus without definite filling defect. Peristalsis was sluggish in this region.

Comment. A young woman who had had chills and a low grade fever for five weeks showed enlarged hilar lymph nodes without parenchymal lung disease in the roentgenograms. Involvement of the esophagus in the inflammatory process was shown by the intimate adherence of the esophagus to the left main bronchus. Six months later, the esophagus showed, in addition, two adhesions just below the bronchus. Biopsy of a supraclavicular gland showed active tuberculosis.

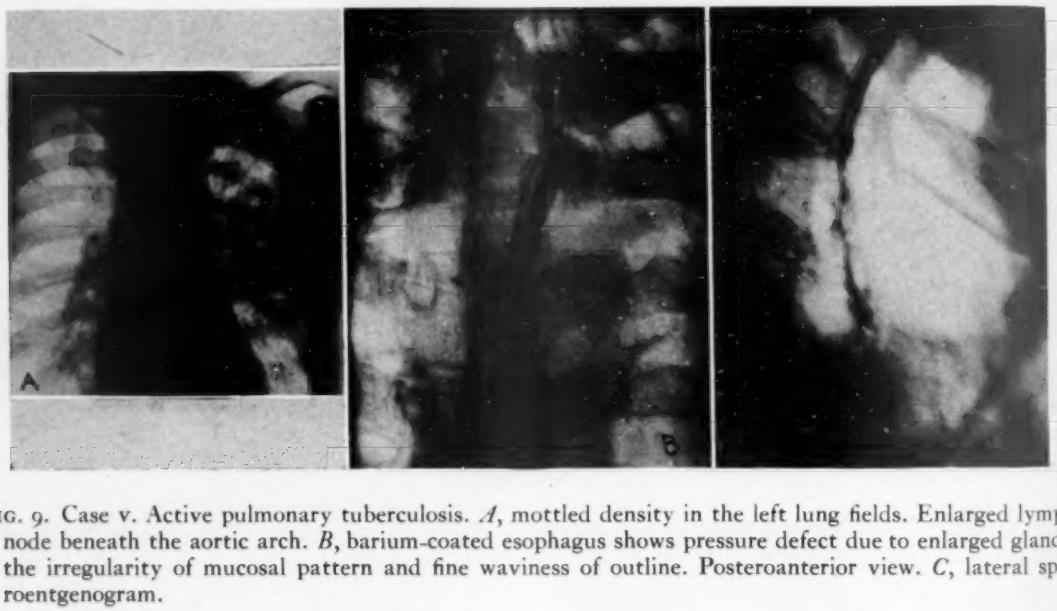

FIG. 9. Case v. Active pulmonary tuberculosis. *A*, mottled density in the left lung fields. Enlarged lymph node beneath the aortic arch. *B*, barium-coated esophagus shows pressure defect due to enlarged glands, the irregularity of mucosal pattern and fine waviness of outline. Posteroanterior view. *C*, lateral spot roentgenogram.

CASE V. (U-264903) *Active Pulmonary Tuberculosis and Mediastinal Adenitis.* (Proved by positive sputum.)

An aching sensation over the left lower anterior chest, not increased by respiration, was the chief complaint of this patient, male, aged sixty-eight. This had been present for six weeks, and for one month he had had an unproductive and paroxysmal cough. There had been increasing dyspnea, weakness, and at times a choking sensation. Examination showed a weak, elderly man with diminished breath sounds in the left posterior chest without râles. The clinical diagnosis was cancer of the lung.

Roentgenologic Examination. There was mottled dullness with calcification in the mid left lung field (Fig. 9*A*). A large gland (arrows) was seen just beneath the aorta, pushing the left main bronchus downwards and the trachea to the right. Above the arch, the trachea was deviated to the left.

Barium swallow (Fig. 9*B* and 9*C*) showed, at the level of the enlarged subaortic gland, a segment of the esophagus about 5 cm. in length which differed from the esophagus above and below. There was a fine waviness of the wall and slight irregularity of the mucosal pattern. There were two small pressure defects on the left side, where small lobulations of the enlarged gland appeared to press against the esophagus.

Bronchoscopy showed marked pressure on the left main bronchus without mucosal in-

volvement. The gastric contents and concentrated sputum contained many tubercle bacilli.

Comment. A case of moderately advanced pulmonary tuberculosis with enlarged mediastinal glands showed a short segment of the esophagus involved at the level of the enlarged glands. There were multiple fine adhesions, some irregularity of the mucosal pattern and two small pressure defects on the esophagus.

PATHOLOGY

Tuberculous mediastinitis usually develops from infection in the tracheobronchial lymph nodes, and infrequently from rupture of a tuberculous focus in the spine, sternum, pericardial or pleural cavities. Though tuberculous mediastinitis is a rare disease, the types of tuberculosis which may lead to it are several. Active pulmonary tuberculosis is the most frequent source. The breaking down, or reactivation, of an old calcified or scarred mediastinal gland, when no active pulmonary tuberculosis is present, may be the cause in older patients. Tuberculous tracheobronchitis rarely gives rise to mediastinitis.[5,12] There may be an acute generalized tuberculous adenitis which, though clearly seen in the mediastinum, has been found also in the cervical and epitrochlear regions.[15]

The tracheobronchial lymph nodes, when infected with the tubercle bacillus, enlarge and coalesce into inflammatory masses.[11] The loose areolar tissue close to the nodes may also become infected, and numerous mediastinal abscesses form. The peri-adenitis which develops, however, may not be purulent but chiefly reactive, and result in multiple adhesions and scars. The firm union of the nodes to one another is due to this peri-adenitis and later scarring. At postmortem examination there is frequently found in the adult a scarred or calcified node, or mass of nodes, firmly bound by adhesions to the trachea or bronchus.

Normally the mediastinal connective tissue stretches loosely from the lymph nodes to the trachea, bronchi, great vessels and esophagus. After infection of this tissue, the resulting adhesions and scars may pull upon and stretch the esophagus, or a scar or part of an inflammatory mass may wholly or partially encircle the esophagus and lead to partial stenosis or a small area of rigidity in its wall. The enlarged lymph nodes may press against the wall or displace the esophagus from its usual course. The infection may spread to the esophagus; with tubercle formation in the wall, ulceration and final rupture into the esophagus may occur.

The above description is of an *active* tuberculous infection in the mediastinum. In the adolescent and young adult the tracheobronchial lymph nodes usually enlarge and later scar and calcify without a generalized mediastinal reaction. The scarring may be marked at one point, however, and may involve a localized point in the esophagus, at which point the scar or adhesions may pull upon the esophageal wall and result in a traction diverticulum. Fischer[2] described a firm adhesion running from a group of lymph nodes to the apex of the diverticulum. He cites Beverman's 60 cases of traction diverticula, 51 of which showed inflammatory changes and scarring in the adjacent lymph nodes. Seventy-three per cent of these changes were tuberculous. Helm[4] described and illustrated with a tracing a traction diverticulum over "an indurated tuberculous process of the inferior tracheobronchial lymph nodes."

ROENTGENOLOGICAL FINDINGS IN TUBERCULOUS MEDIASTINITIS WITH PARTICULAR REFERENCE TO THE ESOPHAGUS

Several roentgenological signs of active tuberculous mediastinitis have been described. Of these the classical sign is widening of the mediastinal shadow to the right and to the left. The association of mediastinal widening with tuberculosis in the lungs, pericardium and vertebrae has been emphasized. Wessler[15] described for the first time enlargement of the hilar and mediastinal glands without pulmonary disease as a manifestation of active tuberculosis in 3 young persons. He called the process "in-

trathoracic tuberculous lymphoma" because of the lobulated mediastinal shadow which simulated tumor. Kornblum and Osmond[10] and Keefer[6,8] described similar cases.

The effect of active tuberculous mediastinitis on the esophagus has not been mentioned frequently in the literature. Displacement or deviation of the esophagus from its usual course has been described.[8,10] Keefer presented a case in which the esophagus was compressed with obstruction to the passage of barium. Kornblum and Osmond[10] found in 1 case an area of constriction with dilatation above and traction diverticula. Belden[1] noted slowness in the passage of barium through the portion of the esophagus adjacent to the infection. I was not able to find a recorded case with actual involvement of the inside of the esophagus by mediastinal tuberculosis. In all 5 of our cases which were seen in the course of one year, changes in the roentgenologic appearance of the esophagus were observed, and in 2 cases actual involvement of the esophageal mucosa was present. Figure 1 shows the significant changes in each case. The black and white tracing was made from spot roentgenograms taken during roentgenoscopy in the posteroanterior projection. The segment of the esophagus which was involved was adjacent to the enlarged glands or inflammatory mass.

Displacement of the esophagus from its usual course by soft tissue masses and pressure defects on the barium-filled lumen were seen in 3 cases. The esophageal mucosa was involved in 2 cases and showed roentgenologically as an irregularity of the normal mucosal pattern. In Case I, postmortem examination showed a large tuberculous ulcer of the esophagus. In Case II, a tuberculous sinus ran from a small diverticulum of the esophagus into caseating mediastinal glands. In Case III, the irregularity of the mucosal pattern was so marked that ulcerations of a carcinoma were simulated. Esophagoscopy, however, showed no abnormality of the mucosa. The irregularity may be due to the folding and kinking of the wall and mucosa by scarring and very small inflammatory masses.

The esophageal wall in the involved area varied in width in 4 cases when the lumen was filled with barium. In some places the lumen was narrower than usual; in others, it was stretched out. In 1 case the lumen, when stretched out, failed to collapse upon itself normally during contraction. The stenosis is due to pressure of inflammatory masses or scarring; the stretching out is probably the result of adhesions. A fistula was demonstrated in 1 case and was found at postmortem in 2 other cases.

In Case IV (tuberculous adenitis), intimate adherence of the esophagus to the left main bronchus was the only indication of peri-esophageal infection. The spot roentgenograms (Fig. 8) show the oblique cylindrical pressure defect of the bronchus. The significant change, however, is the sharp edge of the barium column where the esophagus meets the bronchus. This is seen only when the esophagus is partially filled (Fig. 8*B*) and is obscured by complete filling (Fig. 8*A*). This sharp definition was produced experimentally in the esophagus by Schatzki and Hawes[14] with an extrinsic object, when the object was *firmly* attached to the esophageal wall. That the esophagus was closely bound to the bronchus by adhesions was confirmed by the demonstration later of adhesions below the bronchus.

The unusual finding in 4 of these cases was a number of projections, appearing either as points or rounded waves, from the involved segment of the barium-filled esophagus. In Case V (Fig. 9), the projections were so numerous that a fine, wavelike outline was given to the esophagus. These projections were not transitory. If in one spot roentgenogram a peristaltic wave happens to be photographed, a rounded projection of the wave will be seen, but in subsequent roentgenograms, taken over a period of several minutes to hours, the same wave is not seen. In our cases, however, the projections were always in the same position from film to film, and after a period of several hours when the patient was examined in the same position. The size and shape of the projections in the in-

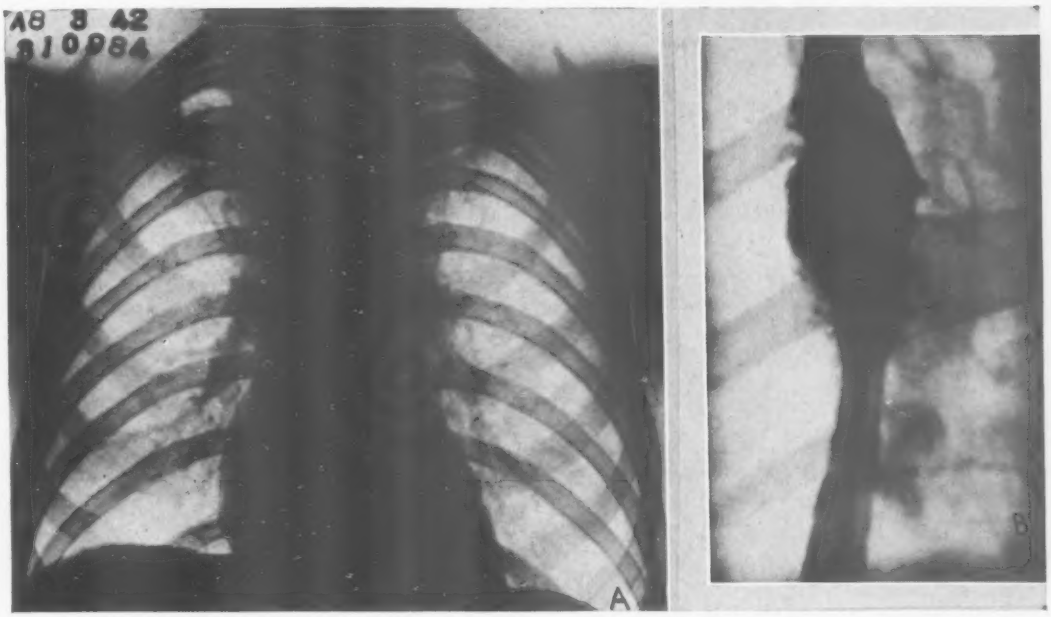

Fig. 10. A case of fibrous mediastinitis and streptococcal paravertebral abscess. *A*, widened superior mediastinal shadow. *B*, spot roentgenogram of the barium-filled esophagus at a level just above the aortic arch shows widening of the lumen and several adhesions.

volved segment, on the contrary, could be varied by the degree of barium filling.

The pathologic explanation of these projections is probably related to the scarring and adhesion formation in the peri-esophageal tissues. In the past, roentgenological changes in the esophagus which are believed to be due to adhesions have been described.

The best known example of the effect of an adhesion on the esophagus is the traction diverticulum, which is frequently seen in adults roentgenoscopically. Schatzki[13] reported a diverticulum with a calcified gland close to the fundus and another within a mass of actinomycotic inflammatory tissue.

Fleischner[3] described another type of diverticulum, a transitory outpouching of the esophageal wall, visible only in the phase between complete barium filling and contraction of the lumen. He attributed its formation to absent contraction at one point in the esophageal wall due to abnormal adherence of this point to the peri-esophageal tissues.

Schatzki[13] called attention to a peculiar phenomenon which is seen occasionally during the contraction of the esophagus. Following deglutition an otherwise smooth esophagus may suddenly show multiple toothlike projections. The phenomenon was called Kräuselung or "curling." These irregularities, although inconstantly present, seem to recur in identical places in a given case. This finding, as well as the fact that "curling" is commonly associated with characteristic adhesion diverticula, has led to the assumption that it is probably produced by localized adhesions of the esophagus. The entire picture cannot be explained on this basis, and it is possible that functional changes may occur secondary to adhesions.

In a case of streptococcal paravertebral abscess which we examined similar changes in the esophagus were demonstrated.

A physician, aged twenty-eight, had had intermittent backache for three years; for one year a paravertebral mass had been seen along the thoracic vertebrae. In August, 1942 (Fig. 10*A*), there was, besides the paravertebral mass, widening of the superior mediastinum. Barium examination of the esophagus (Fig. 10*B*) showed the small projections from the wall of

the barium-filled esophagus which were interpreted as adhesions. The lumen was irregular in width and failed to collapse upon itself on contraction of the remainder of the esophagus. The lung fields were clear.

Aspiration of the paravertebral mass drew out non-hemolytic streptococci.

The patient became anuric and died.

Postmortem Examination. The posterior and superior mediastinum contained a large amount of firm fibrous tissue from the level of the eighth to the tenth dorsal vertebrae. This fibrous tissue was 0.5–2.0 cm. in thickness, and at the level of the fourth and fifth dorsal vertebrae it encircled the esophagus and was adherent to the posterior tracheal wall. In one place a firm, fibrous band constricted the lumen slightly. Posterior to this thick fibrous mediastinal tissue mass, there was a shallow paravertebral abscess which did not communicate with the major mediastinal cavity.

Comment. The segment of esophagus shown roentgenologically as involved by adhesions was found at postmortem examination to be surrounded by thick fibrous tissue which narrowed and pulled upon the esophagus.

Projections, as discussed above, are not physiological, but are due to the peri-esophageal tissue changes, and are analogous in etiology to traction diverticula, Fleischner diverticula, and probably "curling." The finding of these projections in the esophagus of a young person is of considerable differential diagnostic importance. In Case 11, their discovery localized the cause of obscure fever to the mediastinum when other roentgenologic and clinical studies had failed. In association with signs of active infection and within mediastinal widening, their demonstration lends considerable weight to the diagnosis of mediastinal infection rather than tumor. One should ascertain that operation on the mediastinum or lungs has not been performed, as such operative trauma may produce numerous mediastinal adhesions.

SUMMARY

1. The roentgenologic changes in the esophagus in five cases of active tuberculous mediastinitis are described. The appearance of the esophagus had been changed by pressure, by adhesions, and by actual involvement of its mucosal surface.

2. The importance of demonstrating esophageal adhesions in the differential diagnosis between mediastinal tumor and infection is emphasized.

I wish to express my appreciation to Dr. A. O. Hampton, who suggested this study, and to Dr. Richard Schatzki, who offered numerous constructive comments and criticism of the manuscript.

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CORRELATION OF ROENTGENOLOGIC AND GASTROSCOPIC EXAMINATIONS

FROM THE STANDPOINT OF THE GASTROENTEROLOGIST*

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IT IS essential that we pause from time to time to take inventory of our diagnostic and therapeutic methods. Too often when something new is offered we are likely to accept it carelessly, being a little too enthusiastic about its virtues and forgetful of its limitations. Ten years ago the flexible gastroscope was introduced and for a few years enjoyed the ardor of its more zealous disciples. Today, however, gastroscopy is in a period of re-evaluation. This study, which is an evaluation of our experience with gastroscopy, is not an attempt to establish the relative superiority of gastroscopy over roentgenology. All students of the subject agree that the methods are supplemental and complemental, not competitive. Furthermore, evidence is accumulating to show that the percentage of accurate diagnoses is greater if both methods are used than if either method is used alone.

In order to determine the value of gastroscopy from the standpoint of the gastroenterologist, we reviewed 938 consecutive examinations made on 842 patients.[1] In this evaluation of gastroscopy let us consider (1) the gastroscopic contributions of primary value, (2) the contributions of secondary value, (3) the failures to contribute information to cases, (4) the reasons for the failures, and (5) a comparison of the roentgenologic and gastroscopic diagnoses in a selected group.

Primary Value of Gastroscopy. Before classifying gastroscopy as making a primary contribution to a case, the gastroscopist had to add an entirely new diagnosis or definitely establish a doubtful diagnosis, thereby materially altering the treatment and prognosis from what it might otherwise have been. With this criterion we found 217 patients, or 25.6 per cent of the 842 patients examined, in whom the gastroscopic examination was of major value as compared to the roentgenologic. In 150 patients, or 17.7 per cent, the diagnosis was established by gastroscopy when other methods had failed, the roentgenologic examination being negative. Most of these were cases of chronic gastritis, but it

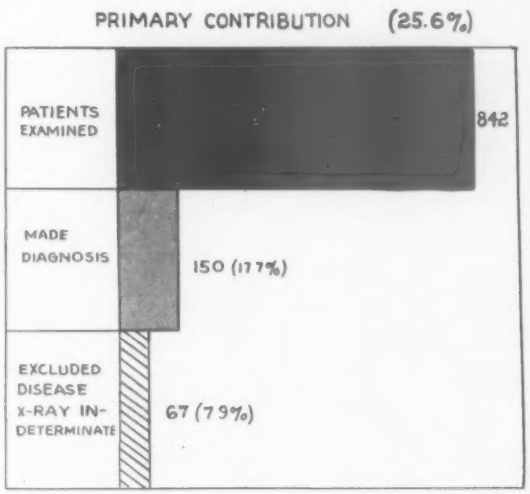

FIG. 1. Gastroscopic diagnosis of major value—a primary contribution.

is significant that there were 10 gastric ulcers not revealed by the roentgenologic examination. It is as important to exclude organic disease as it is to establish its presence. In 67 patients, or 7.9 per cent of all examined, the roentgenologist suspected gastric ulcer or cancer. In each instance the gastroscopist had adequate and satisfactory visualization of the area in question and could state definitely that no organic disease was present, thereby adding a major contribution to the case.

* Presented at the Forty-third Annual Meeting, American Roentgen Ray Society, Chicago, Ill., Sept. 15–18, 1942.

Secondary Value of Gastroscopy. Gastroscopy was of secondary importance as compared to the roentgenologic examination in 55.4 per cent (Fig. 2). We believed that confirmatory evidence was of some value although not of primary significance. The gastroscopic confirmation of a roentgenologically normal stomach in 238 cases, 28.3

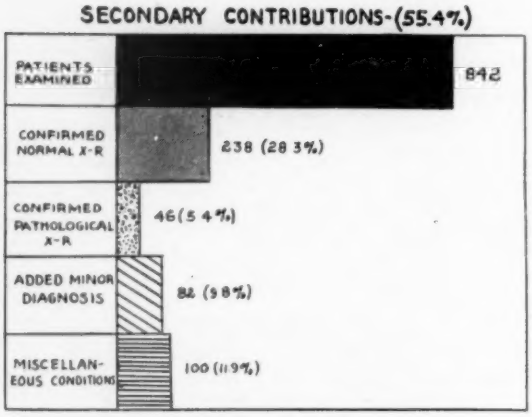

FIG. 2. Gastroscopic diagnosis of secondary importance compared to major diagnosis.

per cent, definitely helped to evaluate those particular cases. Likewise, the confirmation of a pathological finding was both of comfort and of value to the clinician, because the percentage of accurate diagnoses is greater when the gastroscopic and roentgenologic diagnoses are in agreement. The remaining 182 cases might be better classified as being of academic interest rather than of secondary value. In 82 of these cases the presence of chronic gastritis with duodenal ulcer was demonstrated. The other 100 cases included such diagnoses as atrophic gastritis with pernicious anemia, pigment spots, and so forth.

Valueless Gastroscopic Examinations. Whereas gastroscopy was of major value in 25.6 per cent and of secondary value in 55.4 per cent of the cases examined, it was of no value in 19 per cent. As shown in Figure 3, the largest number of unsuccessful examinations occurred because the gastroscopist failed to visualize a lesion or an area where the roentgenologist suspected or demonstrated a lesion. There were 58 such instances. The next largest number was due to anatomical difficulties such as esophageal spasm, acute angulation of the esophagus preventing entrance of the gastroscope into the stomach, or angulation of the instrument beyond its useful range from other causes. The indeterminate and wrong diagnoses ranked third with 33 cases. Unusually large blind spots were present in 13 examinations. In 9 instances the patient's cooperation was so poor that the examination was incomplete. Twenty-four stomachs were examined postoperatively, and 5 times the stoma was not satisfactorily seen. These should be properly classified as "area in question not seen," but for statistical purposes the stomachs examined postoperatively were considered separately. In 4 instances the instrument did not function properly. Twice reactions to the medications used in the preparation of the patient and once a gastric hemorrhage prevented carrying out a gastroscopic examination for which the patient had been prepared.

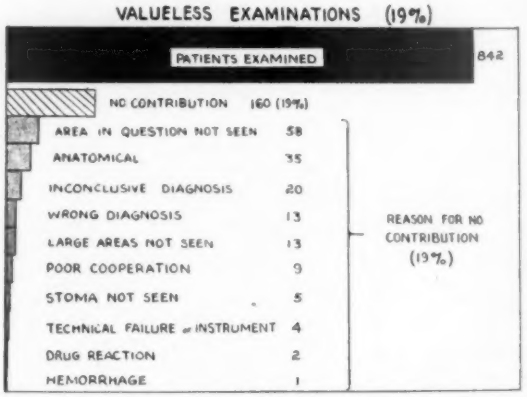

FIG. 3. Gastroscopic examination of no value. Reasons for no contribution to case history.

Limitations of Gastroscopy. Of the limitations of gastroscopy, the technical and optical problems are probably the least well known by the clinician. Of all endoscopes the gastroscope is longest and traverses the most tortuous and difficult route. The Schindler-Cameron gastroscope contains 54 lenses. If for anatomical reasons the in-

strument is flexed beyond 42°, the image is not transmitted from one lens to the next. Severe temporary esophageal or gastric spasm may render the examination incomplete. The shape and size of the stomach is constantly changing because of (1) respiratory excursions, (2) peristalsis, (3) cardiac and aortic pulsations, (4) passive distention with air, or (5) collapse. The gastroscopist, therefore, sees a "moving picture," and what may be seen at one movement cannot be visualized again. Although the roentgenologist may experience difficulties due to body build and position of the stomach, it is not comparable with the gastroscopist's problem. Furthermore, the roentgenologic examination may be easily prolonged or repeated almost at will. The gastroscopist can inspect the mucosa only, while the roentgenologist sees the entire stomach wall. But more important than these problems are the gastroscopic blind spots. Certain areas are never seen or are so seldom partially visualized that they may be considered as "constant blind areas" (Fig. 4). These include an area at the tip of the instrument,

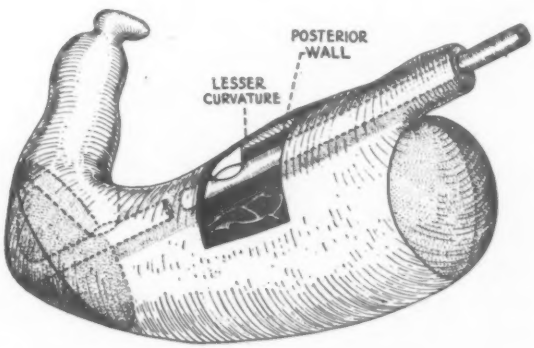

Fig. 4. Constant blind areas. Strip on posterior wall of body may actually be larger than indicated.

extending over the greater curvature; the lower anterior and posterior walls opposite the incisura angularis; the posterior wall of the body immediately adjacent to the instrument; the extreme upper portions of the lesser curvature; and a large portion of the fornix. Occasionally, one may see a portion of these areas, especially the posterior wall of the body, but for practical purposes they are "constant blind areas." In addition to these areas there are others which are seen with variable frequency. These "inconstant blind areas" include the pylorus, lesser curvature of the antrum, usually large amounts of the posterior wall of the body, and at times other areas depending on anatomical factors.

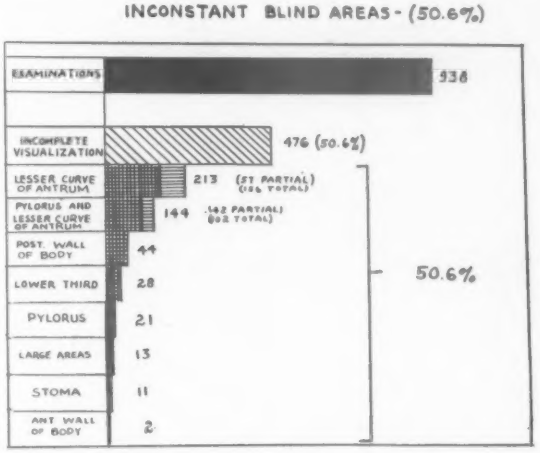

Fig. 5. Inconstant or variable blind areas.

Since the inability to visualize the area in question occurred so frequently, the gastroscopic examinations were analyzed according to the variable or inconstant blind areas (Fig. 5). Four hundred and seventy-six of the 938 examinations were to some degree incomplete, although in only 118 cases was the examination totally unsatisfactory because of technical reasons. Failure to visualize a part or all of either the pylorus or lesser curvature of the antrum in 378 patients accounted for 79.4 per cent of the 476 incomplete examinations. The remaining cases included those in which an unusually large amount of the posterior wall, the lower third of the stomach, the stoma, the anterior wall, or a combination of these large areas were not satisfactorily visualized.

One point here needs emphasis, namely, the matter of multiple gastroscopic examinations in the same patient. An incomplete or indeterminate gastroscopic exam-

FIG. 6. Antral deformity was persistent in all views and during roentgenoscopy. Interpreted as cancer.

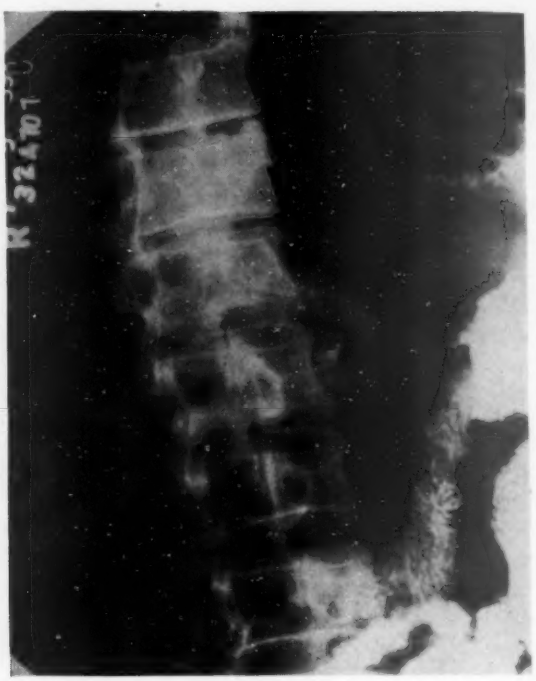

FIG. 8. Second roentgenologic examination three weeks later. Antral deformity persistent at roentgenoscopy and unable to keep barium in antrum for satisfactory roentgenograms.

ination does not mean that all subsequent examinations will be unsatisfactory any more than the same may be said of the

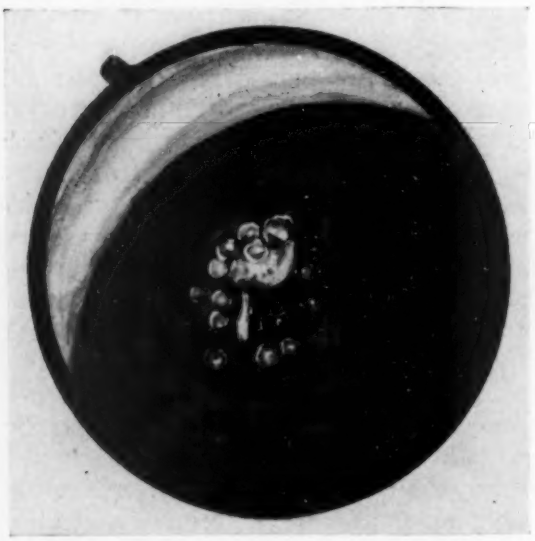

FIG. 7. Gastroscopic view. Findings indeterminate. Unable to state whether orifice with bubbles regurgitating represented pylorus or proximal end of antral deformity.

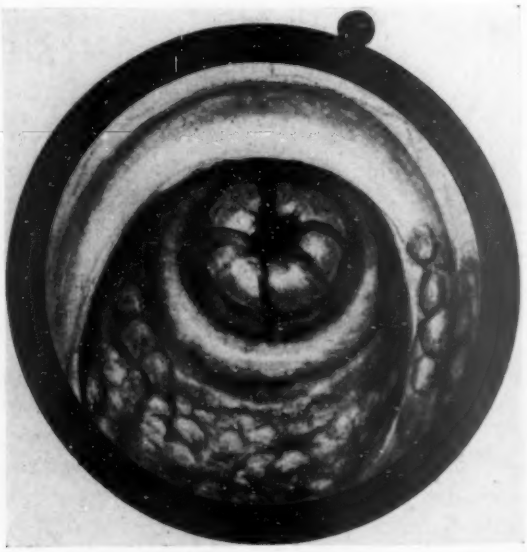

FIG. 9. Second gastroscopic examination showing pylorus in partial contraction with approaching peristaltic wave. Typical changes of hypertrophic gastritis.

roentgenologic examination. It has been our observation that the clinician may be willing to request one gastroscopic examination, but it is uncommon that subsequent examinations are requested although the roentgenologic examination may be repeated many times. We believe this is due to lack of faith and knowledge or a to misunderstanding of some of the limitations of gastroscopy. As a matter of fact, "progress" or repeated gastroscopic examinations should be used. In certain cases we have learned more from "progress" gastroscopic examinations than from the "progress" roentgenologic study. One case which is typical of several in our experience will illustrate the point.

A man aged forty-nine consulted us because of (1) epigastric pain, (2) substernal pain, and (3) bowel distress. After complete investigation diagnoses were made of arterial hypertension with coronary artery disease and angina pectoris, chronic cholecystitis, cholelithiasis, and diverticulosis of the colon. In addition, roentgenologic examination revealed a persistent annular prepyloric defect (Fig. 6) interpreted as cancer. At the first gastroscopic examination (Fig. 7) we were uncertain and indeterminate about our diagnosis. Three weeks later the roentgenologic findings were essentially the same (Fig. 8), but the gastroscopic picture was entirely different (Fig. 9). All parts were well seen, and there was no doubt about the diagnosis of hypertrophic gastritis. Today, two years later, this man is subjectively much improved and objectively no worse.

Table I

Comparison of First Roentgenologic and Gastroscopic Examinations

	Normal	Hypertrophic Gastritis with Normal or Hypertrophic Rugae	Benign Tumor or Polyp	Benign Ulcer	Cancer	Gastritis with X-Ray Ca. or Ulcer	Stoma Ulcer	
Diagnosis in Agreement	43 (4)	39 (6)		9 (13)	18 (16)			109 (29)
Gastro-Correct X-Ray Incorrect Or Indeterminate	4		1 (1)	5	7 (4)	6 (1)		23 (6)
X-Ray Correct Gastro-Incorrect Or Indeterminate			1 (1)	9	(4) 4		1	
Both Incorrect	1			3 (3)	5 (5)			9 (8)
Both Indeterminate							14	14

* Figures in parenthesis indicate diagnoses proved by operation or autopsy.

Comparison of Roentgenologic and Gastroscopic Diagnosis. In the foregoing discussion gastroscopy has been considered in relation to roentgenology and the patient. However, in order to compare the accuracy of the roentgenologic and gastroscopic diagnosis, we selected 170 patients (Table 1) who had been observed for one year or longer, or in whom operations or autopsy had established the true diagnosis. As the gastroscopic and roentgenologic examinations were done within a few days of each other, they were comparable. Only those gastroscopic examinations in which areas

except the constant blind areas were visualized were accepted for study. Furthermore, since the first examination is so important and largely decides the clinician's choice of therapy, only the first examinations were considered. There were 109 cases, or 64.1 per cent, in which both the roentgenologist and gastroscopist were in agreement. Of these, 43 stomachs were normal, 9 had benign ulcer, 18 had cancer, and 39 had chronic gastritis with a roentgenologic report of either a normal stomach or with hypertrophic rugae. The latter group were classified as being in agreement because our roentgenologists believe it is chiefly the gastroscopist's prerogative to make a diagnosis of chronic gastritis.

In 15 cases the roentgenologist's diagnosis in the first examination was correct, while the gastroscopist's diagnosis was either indeterminate or incorrect. Nine of these cases were benign ulcer, 1 of which was an indeterminate diagnosis and 8 of which could not be seen gastroscopically, 4 cancer, 1 benign tumor, and 1 gastroenteric stomal ulcer.

In 23 patients the gastroscopist first made the correct diagnosis. It should be emphasized that a diagnosis was considered as indeterminate if the examiner qualified the diagnosis in any way, even though in his own mind he definitely favored a single unqualified diagnosis. Diagnoses such as "ulcer, probably benign but malignancy not definitely excluded" made by either the gastroscopist or roentgenologist were classified as indeterminate. If a lesion seen by one method was not seen by the other, it was an indeterminate examination for the latter method. In this group of 23 patients there were 4 gastroscopically normal cases in which the roentgenologist suspected a lesion. There were 6 cases of chronic gastritis causing a deformity which at first was suspected as being due to cancer or ulcer. There were 5 cases of benign ulcer, 2 of which were not seen roentgenographically, 7 of cancer, and 1 of benign tumor with an indeterminate roentgen report.

These three groups account for 147 of the 170 cases, or 86.4 per cent, in which both or one of the examiners made the correct diagnosis. In contrast to this there were only 9 instances, or 5.3 per cent, in which both the roentgenologist and gastroscopist were incorrect, and 14 cases in which both were indeterminate.

CONCLUSIONS AND SUMMARY

On the basis of our review of 938 gastroscopic examinations in 842 patients, we believe gastroscopy has a definite but limited diagnostic value. Certain cases cannot be considered as having been adequately and properly studied unless a gastroscopic examination has been done. From the standpoint of the gastroenterologist, these include (1) cases in which the roentgen findings are negative, but in which upper gastrointestinal disease is still suspected; (2) cases with indeterminate or inconsistent roentgenologic findings; (3) gastric ulcer especially while being treated; and (4) cancer except in advanced, terminal, or obvious cases.

It was our experience that gastroscopy was of primary or major value in 25.6 per cent of all cases examined. The primary value consisted of establishing a diagnosis which had not been made by other means or definitely making a diagnosis which by other means was indeterminate or incorrect. There were 17.7 per cent with negative roentenologic examinations in which gastroscopy revealed pathema (140 cases of gastritis and 10 cases of ulcer). In 7.9 per cent the roentgenologist suspected pathema which was excluded by gastroscopic examination.

It was also our experience that gastroscopy was of no value in 19 per cent of the cases. The chief cause of failure was the gastroscopist's inability to visualize certain areas where a lesion had been demonstrated or was suspected by the roentgenologist. Incorrect or misleading diagnoses constituted only 3.9 per cent of all cases examined.

A comparison of roentgenologic and gastroscopic diagnoses in a series of proved

diagnoses revealed that while the roentgenologic examination was still the most valuable single examination, the gastroscopist was no more likely to make the correct diagnosis or to err in judgment than the roentgenologist. Likewise, in the matter of differentiating between a malignant and benign lesion, the gastroscopist is not superior to the roentgenologist. In 60 instances of cancer or benign ulcer both examinations were in agreement in 27 cases. The gastroscopist was indeterminate or incorrect 13 times, the roentgenologist 12 times, and both were incorrect in 8 instances. Obviously, then, the proper procedure to follow when the roentgenologic and gastroscopic findings are not in agreement is further study and observation of the case utilizing both "progress" roentgenologic and gastroscopic examinations.

REFERENCE

1. Renshaw, R. J. F., Clark, G. E., Jr., and Forsythe, J. R. Critical analysis of 938 gastroscopic examinations. *Am. J. Digest. Dis.*, 1942, 9, 401–404.

DISCUSSION

Dr. Frederick E. Templeton, Chicago, Ill. For the past eight years I have worked in close association with Dr. Rudolph Schindler in comparing roentgen examinations with gastroscopy. From time to time we have been on opposite ends of the scale in our interpretation of these findings. Some of our reports, of course, are recorded in the literature. It is therefore very gratifying to me that the paper of Dr. Renshaw bears out my own opinions.

There are a few points, I believe, that should be emphasized. One is the identification and differentiation of chronic gastritis. The only gastritis we can identify is the hypertrophic form. In our experience this has included a very small number of cases of the hypertrophic gastritis, which the gastroscopist reported. The differentiation between a benign infiltrating lesion, such as hypertrophic gastritis, and an infiltrating cancer is extremely difficult and usually cannot be made with any degree of assurance by roentgenologic or even gross pathologic examination. The microscopic examination is the only sure method.

The gastroscopist, of course, diagnoses gastritis with far greater frequency than we roentgenologists, but I should like to ask Dr. Renshaw how many of these cases of gastritis are really of clinical significance.

There are a significant number of ulcers which we, as roentgenologists, cannot see. The existence of some of the ulcers has been demonstrated by pathologic examination. Most of the ulcers we do not see are the shallow forms. I sometimes wonder whether every white spot seen on the mucosa by the gastroscopist can be differentiated from a little collection of mucus. I know that Dr. Schindler has experienced difficulty making the differentiation. I should like to ask Dr. Renshaw how sure he can be or how many times he can be certain that some little area which looks like an ulcer is really an ulcer.

We all know that there are certain types of ulcerating carcinomas that we cannot differentiate from benign lesions. It has been stated that the disappearance of an ulcer under clinical management is not very helpful in differentiating between benign and malignant ulcers. We have used another sign, which is based more on theory than on proof; therefore, I cannot state it as a fact. We put the patient on clinical management. We watch the crater disappear. The crater of an ulcerating carcinoma in the presence of free acid will fill up with carcinomatous tissue and the crater disappear, when the acid is neutralized. The infiltration, however, remains. We can observe this infiltration both at roentgenologic and gastroscopic examination. In many benign ulcers the infiltration disappears. We now use this criterion. If the ulcer and the infiltration disappear during medical treatment we are probably dealing with a benign ulcer. The reverse is not necessarily true for inflammatory infiltration may remain after a benign ulcer heals.

In the past some gastroscopists have voiced their ability to determine the operability of carcinoma. New surgical techniques I think pretty well rule out any chance for the roentgenologist or the gastroscopist to determine the operability of a carcinoma. Distant metastases are apparently the only thing that prevent the surgeon from removing a neoplastic process. At our hospital the surgeons take out the pancreas, the spleen, the lower end of the esophagus; in fact, they sometimes clean out the whole left upper quadrant in removing a carcinoma of the stomach which has infiltrated the surrounding structures.

DR. RENSHAW (closing). It is a pleasure to have been invited as a gastroenterologist to appear on this program. I wish to express my gratitude for the privilege of being with you, and I wish to thank the discussants for their kind remarks.

The question of the personal factor in interpretation of a lesion has been presented. I tried to emphasize it in my paper, stating that our roentgenologic examinations were done by several examiners each with a different degree of experience and skill. A certain number of the indeterminate or unsatisfactory roentgenologic examinations were done by the less experienced examiners. The gastroscopic interpretations, on the other hand, were all done by one person.

The differentiation of an erosion from a small shallow ulcer is not always easy by gastroscopy. Our experience has been similar to Templeton's and Schindler's in that the majority of so-called gastric ulcers which were visualized by the gastroscopist and not by the roentgenologist appeared to be shallow. However, it should be emphasized that it is extremely difficult to judge the depth of an ulcer crater gastroscopically. I believe the gastroscopic appearance to be more shallow than is actually the case. I recall one very interesting and instructive case wherein we visualized an ulcer that was not seen roentgenologically. This patient had been twice examined elsewhere by a competent roentgenologist and at least twice by another gastroscopist. An ulcer was demonstrated by the gastroscopist but not by the roentgenologist. Several months later the patient presented himself at the Cleveland Clinic. Knowing the previous history, our roentgenologist made a special effort to demonstrate the lesion but was unsuccessful, yet I had no difficulty in visualizing an ulcer crater of moderate depth in the lesser curvature near the angularis. We had the same experience at two subsequent examinations. When the patient submitted to surgery and a partial gastric resection was done, we found an ulcer crater 2.5 by 2 cm. in diameter and 0.5 cm. deep with early malignant changes in the edges. One would think an ulcer of this size should have been visualized on at least one of the roentgenologic examinations. I have no satisfactory explanation for the roentgenologic failures.

Small erosions which might be confused with, and which should be differentiated from, mucus patches or barium flecks would not be confused with or classified as shallow gastric ulcers.

Dr. Templeton has asked about the clinical symptoms of gastritis in 25.6 per cent of our group where we thought gastroscopy had made a primary contribution. I can answer that by saying that I went over a series of 300 cases which are included as the first 300 of this present series of 842 patients. I excluded cases of cholecystic disease and other conditions which might account for the patient's symptoms. Even patients who used cathartics in the presence of irritable colon or patients with a large functional element were excluded. In the remaining group where were not over 6 per cent in whom we thought the gastritis was of clinical significance. I have repeatedly emphasized to my colleagues that the mere finding of mucosal changes does not mean active disease. The gastric mucosal changes should be regarded as roentgenologists regard a duodenal bulb deformity. Bulb deformity without a visible crater may mean an old ulcer or it may mean an active duodenal ulcer. Gastric mucosal changes may mean active or inactive disease. It is up to the clinician to decide whether the changes represent active disease or not.

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COMMON CONGENITAL ANOMALIES OF THE BONY THORAX

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ALTHOUGH several articles describing congenital anomalies of the bony thorax have appeared in the foreign literature, search has failed to reveal any survey of the subject in the American literature*, and only one paper on this theme in the English literature.[1] It seemed of interest, therefore, to investigate the nature and incidence of congenital variations in a series of routine chest roentgenograms.

Material. The roentgenograms studied were taken as part of the entrance physical examination given yearly to the freshman class at Dartmouth College. The subjects are males, almost all of the age of nineteen or twenty years. Since White, in 5,000 routine hospital chest roentgenograms found an incidence of 1 per cent in both males and females, the figure for percentage incidence found in this series would presumably be applicable to both sexes. For individual anomalies, however, the same author found variations in incidence between males and females. Two thousand roentgenograms were reviewed to provide the material studied.

Etiology. In the development of the embryo, the primitive mesoderm undergoes a process of segmentation into a series of somites. A portion of the mesoderm of each somite differentiates into the sclerotome, from which the vertebra is developed. The rib is derived from an outgrowth of the developing vertebra. It is generally held that anomalies occur as a result of irregular segmentation in the first step of division of the mesoderm into somites.

* Since the preparation of this paper, the following papers have been published: Steiner, H. A. Roentgenologic manifestations and clinical symptoms of rib abnormalities. *Radiology* 1943, *40*, 175; Etter, L. E. Osseous abnormalities of the thoracic cage seen in forty thousand consecutive chest photoroentgenograms, AM. J. ROENTGENOL. & RAD. THERAPY, March, 1944, *51*, 359.

Incidence. A total of 56 anomalies was observed, an incidence of 2.8 per cent. The type and distribution of the anomalies is given in Table I.

TABLE I
TYPE AND NUMBER OF ANOMALIES

Bifurcation	20
Cervical rib	10
Rudimentary first rib	10
Flaring	6
Fusion	6
Bridging	4
	56

Bifurcation. Bifurcation of the anterior end of a rib occurred in 20 cases, all involving the third, fourth, or fifth rib and almost equally distributed among the three (Table II). The majority (13) were on the right side. The notch formed by the bifurcation may be shallow and asymmetrical as in Figure 1, or deep and symmetrical as in Figure 2. One case (Fig. 3) showed bifurcation of two ribs.

TABLE II
BIFURCATION

Third rib	6	Right	13
Fourth rib	8	Left	8
Fifth rib	7		

Flaring. Flaring of the anterior end of the rib was found in 6 cases, distributed as shown in Table III. A typical example is seen in Figure 4. The slight notching in 1 case (Fig. 5) suggests a close relationship between this and the preceding anomaly.

Fusion. Fusion of two adjacent ribs occurred in 6 cases, all but one in the first two ribs, and none below the third (Table IV). Fusion in all cases was incomplete,

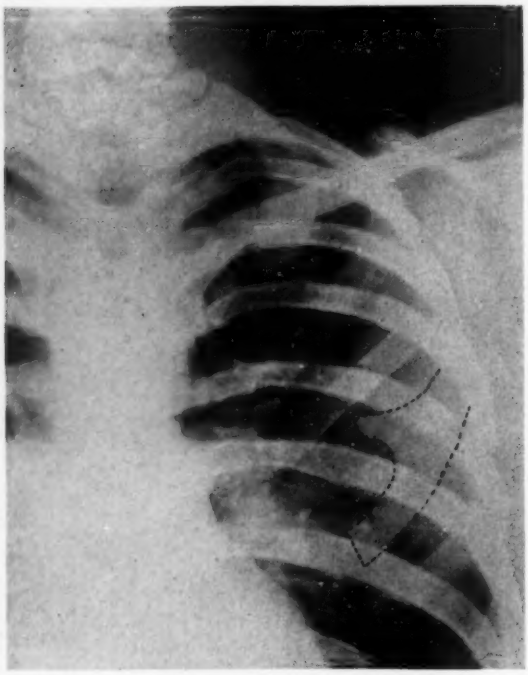

Fig. 1. Bifurcation.

with a bifurcated anterior extremity (Fig. 6). Two cases presented multiple anomalies: one, fusion of the first and second ribs, incomplete development of the fourth, and flaring of the fifth (Fig. 7); the other, fusion of the first and second ribs, associated with a hemivertebra (Fig. 8).

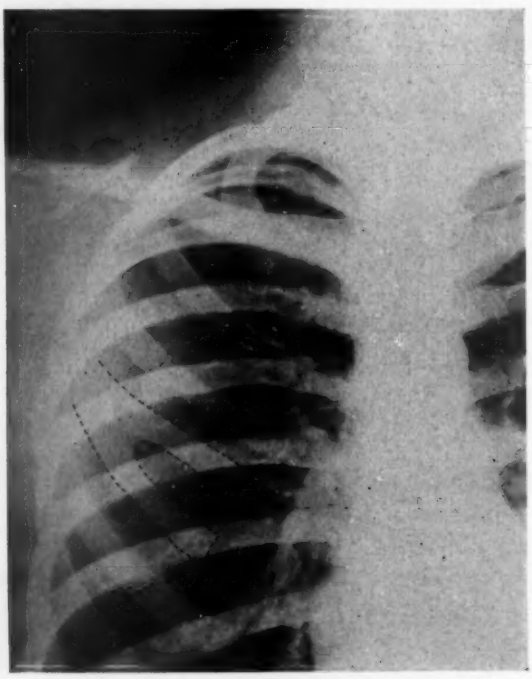

Fig. 2. Bifurcation.

Table III

FLARING

First rib	1	Right 4
Fourth rib	2	Left 2
Fifth rib	3	

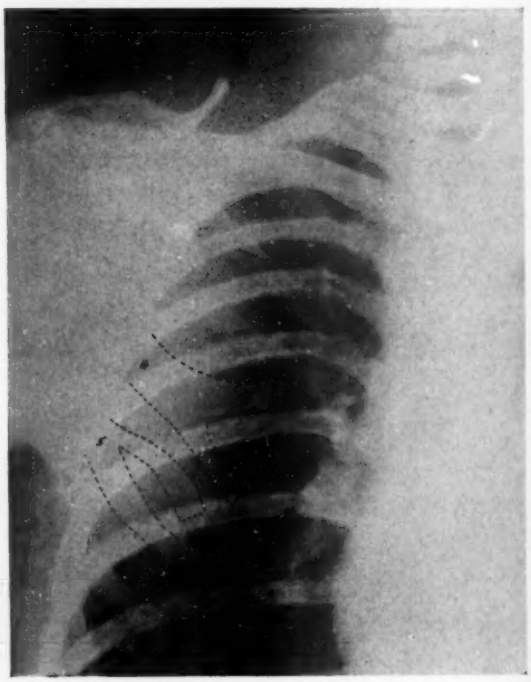

Fig. 3. Bifurcation of two ribs.

Bridging. Apparently closely allied to the preceding, bridging between two ribs may be complete as in Figure 9 or incomplete as in Figures 10 and 11. Four cases were observed, distributed as in Table v.

Table IV

FUSION

First and second ribs	5	Right 4
Second and third ribs	1	Left 2

Table V

BRIDGING

First and second ribs	3	Right 2
Second and third ribs	1	Left 2

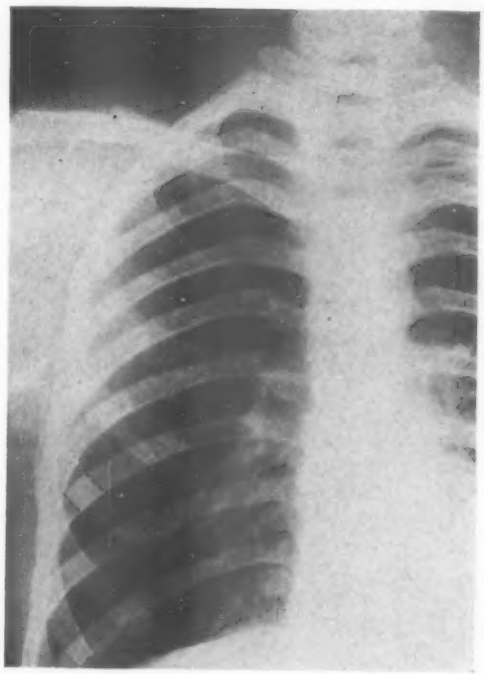

Fig. 4. Flaring.

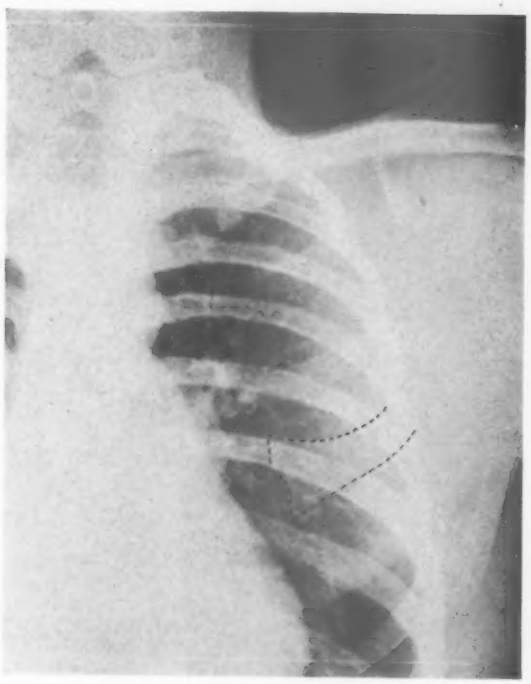

Fig. 5. Flaring.

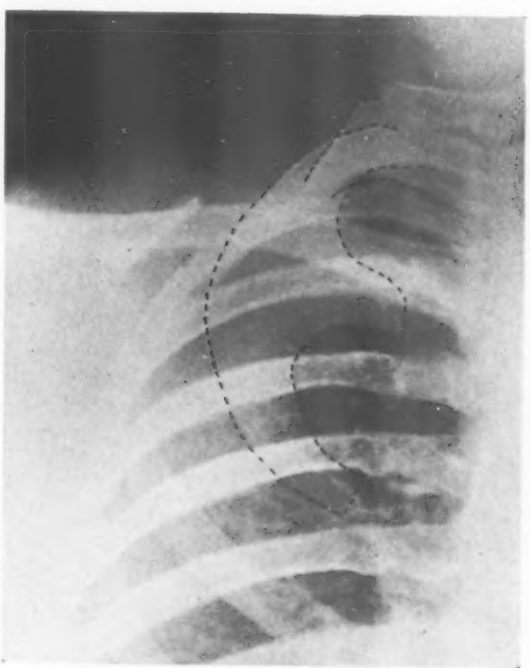

Fig. 6. Fusion.

Fig. 7. Multiple anomalies.

Fig. 8. Fusion associated with hemivertebra.

Cervical Rib and Rudimentary First Rib. Ten cases of each of these variations occurred, the differentiation between the two being made by observing the relationship of the anterior end of the rib to the sternum. It will be seen by reference to Tables VI and VII that the majority of cases of cervical rib were bilateral, whereas the majority of rudimentary first ribs were unilateral. In the case of cervical ribs, the majority united with the first rib; with rudimentary ribs, the anterior end was free in the majority of cases.

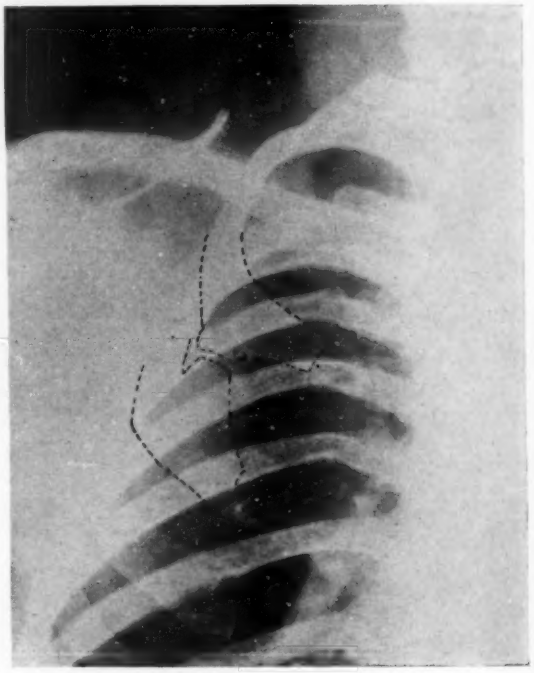

Fig. 10. Partial bridging.

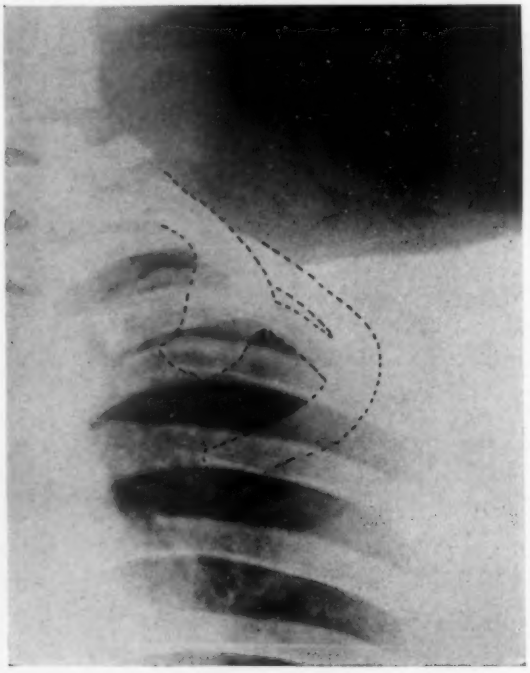

Fig. 9. Bridging.

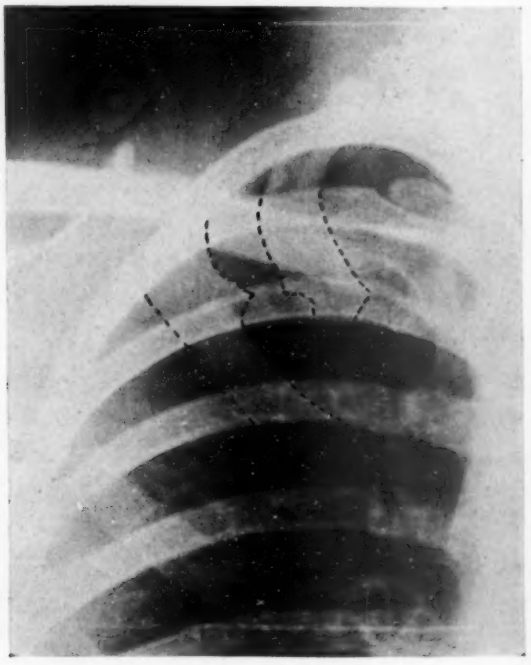

Fig. 11. Partial bridging.

TABLE VI

CERVICAL RIB

Bilateral	7	Free end	5
Right	3	Union with first	11
Left	0	Articulation with first	1

TABLE VII

RUDIMENTARY FIRST RIB

Bilateral	4	Free end	11
Right	2	Union with first	2
Left	4	Articulation with first	1

"Fracture" of the First Rib. One cervical rib and one first rib revealed a solution of continuity as shown in Figures 12 and 13.

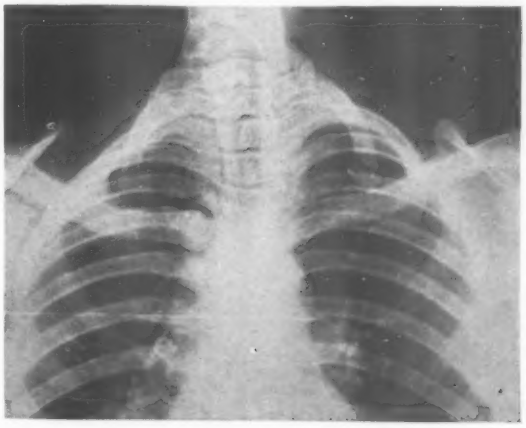

FIG. 12. Anomaly of first rib simulating fracture.

FIG. 13. Anomaly of first rib simulating fracture.

This is similar in appearance to some of the lesions which have been described in several papers as fracture of the first rib. It has

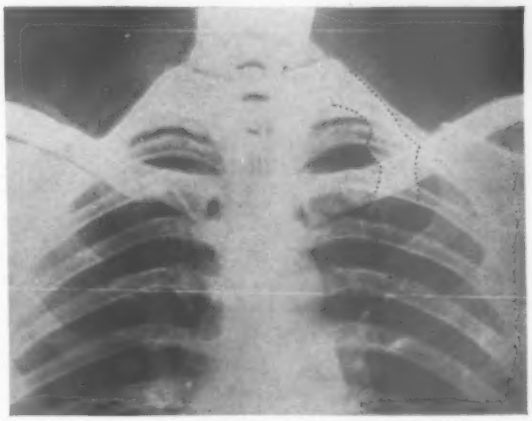

FIG. 14. Possible anomaly simulating healed fracture.

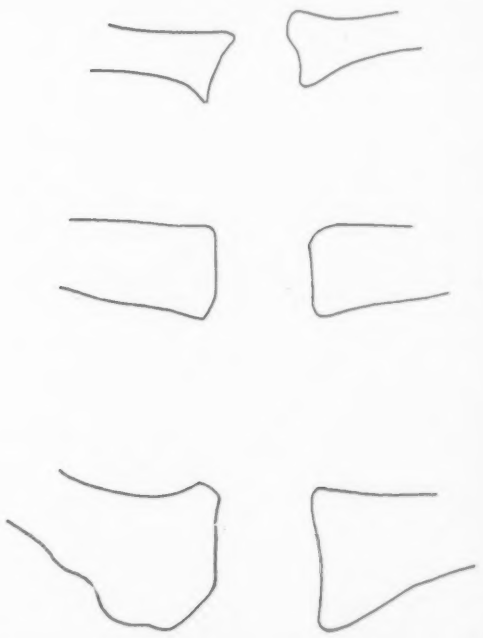

FIG. 15. Variations in medial end of clavicle.

been considered that such a fracture can be produced by muscle traction as well as by direct or indirect trauma. Figure 14 shows an appearance which is apparently the end-result of the same process. In none of the 3 cases was a history of trauma or disability obtained. It is recognized that this by no

means rules out the possibility of fracture, since the symptoms may not have been severe enough to fix the incident in the patient's memory. Certain factors in addition to the negative history, however, raise the question as to whether we may be dealing with an anomaly of some type. The line of diminished density is broader and more irregular than is usually seen in fracture of other ribs. Non-union of rib fractures is rare, and 1 case (Fig. 13) showed the same findings at two different examinations one year apart. We have seen that the cervicothoracic junction is a frequent site of congenital anomaly, and in 1 case there was an associated fusion of the fifth and sixth cervical bodies. These conditions, therefore, suggest the possibility that some "fractures" of the first rib may actually be cases of congenital anomaly to which attention is called by a superimposed injury.

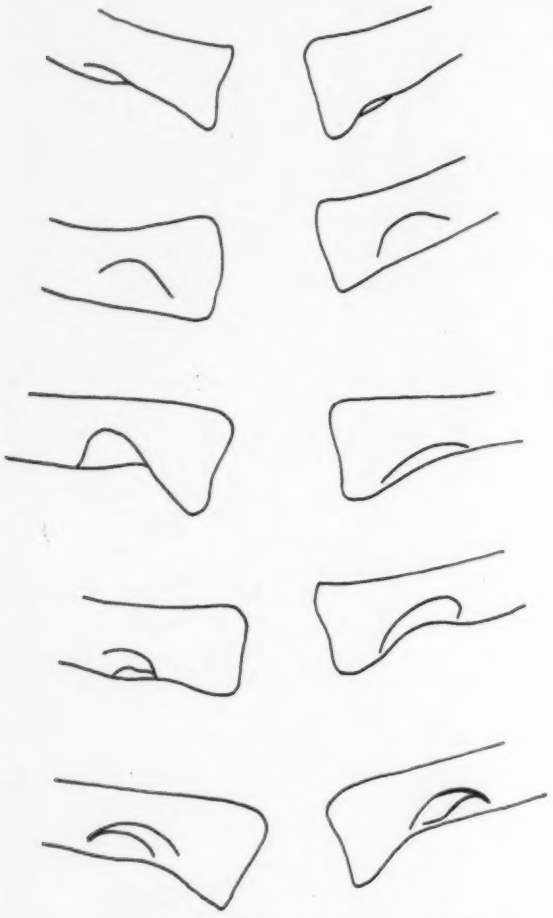

FIG. 16. Rhomboid fossa of clavicle—bilateral.

TABLE VIII

RHOMBOID FOSSA OF CLAVICLE

Total number in 500 subjects	121	24%
Bilateral	71	58%
Right	26	21%
Left	24	21%

Rhomboid Fossa of the Clavicle. Although this entity does not strictly fall under the heading of congenital anomaly, the recent publications of Pendergrass and Hodes[2] and of Shulman[3] stimulated a study of its occurrence. The shape and size of the medial end of the clavicle varied markedly as indicated

FIG. 17. Rhomboid fossa of clavicle—unilateral.

in Figure 15. The fossa was considered to be present when a definite double contour could be seen on the roentgenogram. A study of 500 consecutive cases revealed an incidence of 24 per cent (Table VIII). Of these, 58 per cent were bilateral and 42 per cent unilateral, equally divided between right and left. The fossa can be shallow or deep, and may be situated at any point from 1.0 cm. to 3.0 cm. from the sternal end of the clavicle. Illustrations of the various types are shown by the tracings reproduced in Figures 16 and 17.

Calcification of the First Costal Cartilage. Another coincidental survey was made to investigate the incidence of calcification of the first costal cartilage. Islands of calcium deposit were a frequent finding, but the early stage of progressive calcification, seen usually as an irregular line along the lower border of the cartilage, was uncommon, occurring in 4 per cent of 500 consecutive roentgenograms. A series of 100 roentgenograms of medical students averaging three to four years older, on the other hand, showed calcification in a greater or lesser degree in 42 per cent. Only one case showed calcification in the other costal cartilages, and in this one the first cartilage was almost completely calcified. From these figures it appears that the beginning of calcification of the first costal cartilage occurs in males in the earliest years of the third decade, and precedes calcification of the other cartilages.

SUMMARY

Congenital anomalies of the bony thorax occurred in 2.8 per cent of two thousand male college students. These anomalies are tabulated and illustrated.

Rhomboid fossa of the clavicle was present in 24 per cent. Its various forms are illustrated.

Calcification of the first costal cartilage was found in 4 per cent of college freshmen, but in 42 per cent of first and second year medical students.

Evidence is presented which suggests that the appearance described by various authors as fracture of the first rib may in some cases be due to a congenital anomaly.

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IMPORTANCE OF THE ROENTGEN EXAMINATION IN THE DIAGNOSIS OF ADENOMA OF THE PROSTATE*†

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IN THE masculine preclimacteric and climacteric (fourth to fifth decades) the prostatic part of the urethra is affected by a tumor formation which grows progressively. Formerly called prostatic struma (Tsunodas), suburethral tumor (Marquis), periurethral adenoma (Motz), prostatic adenoma (Legueu), hypertrophy of the prostate (Mercier), periprostatic adenoma (Rubritius), it is now more properly called adenoma of the prostatic urethra.

The substrate of this structure is an intense cellular hyperplasia of the submucous or suburethral glands (of endodermal origin), sometimes called Lendorf's accessory periurethral glands.

These glands are distributed in groups from the internal ring to the submontanal part of the prostatic urethra (Fig. 1 and 2).

Horn-Orator has made a systematic classification of these groups as follows: (*a*) the trigone or subcervical group (Albarran's group); (*b*) colliculus group (lateral group); (*c*) distal group (ventral group or group of the head of the prostatic urethra).

The clinical forms of adenoma of the prostate are characterized by the solitary or combined growth of these cell groups (Fig. 3): (*a*) total adenoma (originating from the lateral, distal and subcervical groups); (*b*) middle lobe or Home's lobe (from the subcervical or trigone group); (*c*) micro-adenoma (miniature form) (from the subcervical group with intrasphincteric growth); (*d*) solitary distal lobe (distal group, or that of the head of the prostatic urethra).

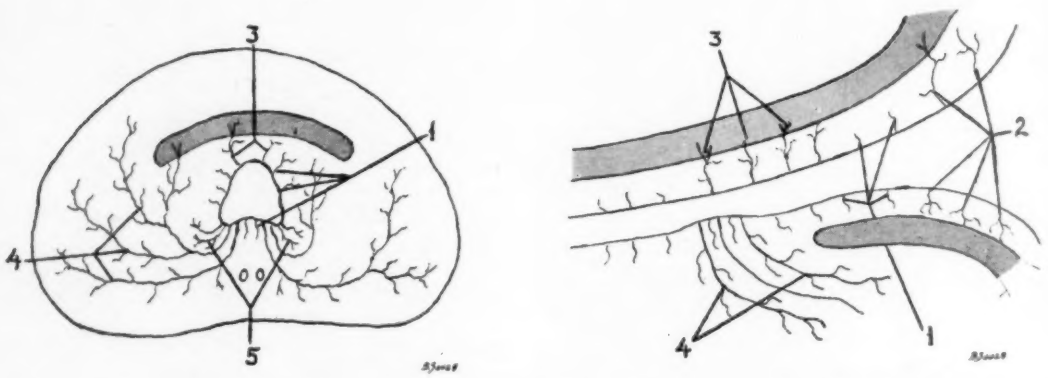

FIG. 1 and 2 (according to Jacoby). *1*, urethral mucous glands; *2*, submucous glands (trigone or subcervical groups); *3*, submucous glands (ventral or distal group); *4*, prostatic glands, properly so-called; *5*, submucous glands (colliculus group).

On the other hand, the prostatic glands properly so called (of mesodermal origin) when affected by tumoral new-growth (adenoma) may cause enlargement of the organ with the same clinical manifestations as total adenoma of the glands of Lendorf (submucous glands).

Here two varieties may be differentiated,

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† Translation made by Dr. Audrey G. Morgan, Fort Scott, Kansas.

from both the clinical and anatomo-pathological points of view: (*a*) "very minute intraprostatic" adenoma; (*b*) fibroadenoma of the prostatic glands (Albarran).

In the growth of the tumor, whether of as that of tumors in general, while adenoma of the suburethral or submucous glands is thought to be due to a hormonal disequilibrium due to change of life (hormonal theory).

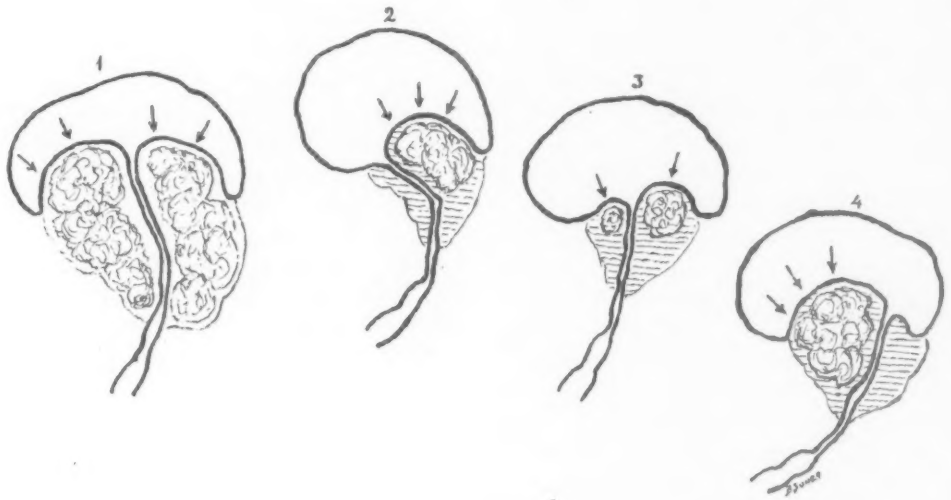

Fig. 3. Clinical forms of adenoma of the prostate. *1*, total adenoma; *2*, middle lobe or Home's lobe; *3*, micro-adenoma (miniature form); *4*, distal lobe.

the variety originating from the submucous glands (total) or of that originating from the prostatic glands properly speaking, the direction of growth may be vesical, subvesical or perineal (Fig. 4).

This difference is of great interest, particularly with reference to indications for operative treatment, since within certain limits it indicates the route to be followed: (*a*) suprapubic transvesical (high section) (Freyer, Fuller, Harris); (*b*) perineal (transverse, median, lateral perineotomies) (Zuckerkandl, Albarran, Young, Wildbolz, Wilms, Berndt, Lowsley); (*c*) ischiorectal (Voelcker); (*d*) transurethral (endoscopic resection).

With reference to the cause of this intense hyperplasia, whether of the suburethral or submucous glands, or of the prostatic glands properly speaking, different theories were formerly advanced (arteriosclerotic, inflammatory, neoplastic, degenerative) but at present the development of adenoma of the prostatic glands, properly speaking, is thought to have the same origin

I refer on this point to the ideas of Lower and his collaborators at the Cleveland Clinic, those of Laquer of Amsterdam and those of Deming of Yale University.

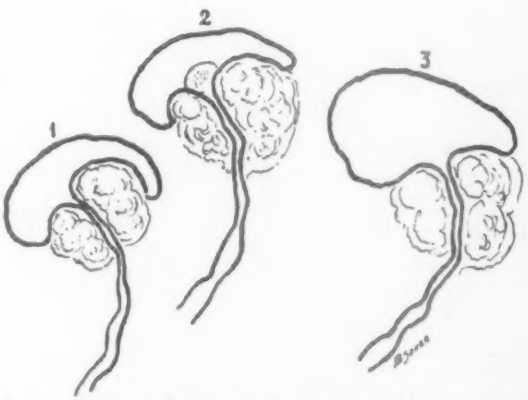

Fig. 4. Forms of growth of adenoma of the prostate. *1*, intravesical adenoma; *2*, part intravesical, part subvesical; *3*, subvesical.

Lower and his collaborators demonstrated an interrelationship between the anterior lobe of the hypophysis, the testicles and the secondary sexual organs of certain

animals; and they assume that this correlation must exist also in man.

McCullagh, Walsh, Moore, Owen, Cutler, Lower and de Jongh in well conducted experiments found that the testicle produces two hormones: the first is androtin, a male sexual hormone, produced by the interstitial cells, which controls the development and maintenance of the secondary sexual glands. Its production is regulated by the anterior lobe of the hypophysis. Hyperfunction of the anterior lobe of the hypophysis stimulates the testicle in such a way that excessive production of androtin causes hyperplasia of the submucous glands, or so-called adenoma of the prostate.

The second hormone, inhibin or contruin, produced by the germinal cells, controls the hypophysis. Normally the germinal cells secrete enough inhibin to prevent excessive secretion of the hormone of the anterior lobe of the hypophysis, but as soon as functional imbalance takes place, with decreased function of the germinal cells, which appears to be caused by change of life (preclimacteric and climacteric) the decreased amount of inhibin permits of greater activity of the anterior lobe of the hypophysis which stimulates excessive production of androtin by the interstitial cells which is responsible for the glandular hyperplasia of adenoma of the prostatic urethra.

According to Lower and his collaborators therefore the absence or decrease of inhibin permits of hyperactivity of the anterior lobe of the hypophysis which stimulates excessive production of androtin, which is responsible for glandular hyperplasia of the suburethral glands or Lendorf's accessory glands.

Laquer of Amsterdam, however, believes that the genesis of adenoma is quite different from this; there is a factor of hormonal disequilibrium, but it is between the androgenous and estrogenic hormones.

In the age of prostatism (the preclimacteric and climacteric) the two sexual hormones are in a condition of balance with each other, with the hormone of the anterior hypophysis and with the hormone of the suprarenal. The hyperplasia of the submucous glands, the so-called benign hypertrophy of the prostate, according to him would be caused by deficiency of the masculine hormone (which would inhibit the hyperplastic action of the estrogenic hormone) and of other gonadotropic substances not inhibited by it. There would therefore be a predominance of estrogenic and gonadotropic hormones.

In addition to these two theories there is that of Deming that the hyperplasia of adenoma of the prostate is caused by the invasion of solid fibromuscular masses from the muscular wall of the urethra into the gland ducts. These solid fibromuscular masses, originating from the müllerian ducts are said to acquire this invasive growth from stimulation by estrogenic hormones. Here, too, there would be disequilibrium between the androgenic and estrogenic hormones.

As soon as the growth of adenoma of the prostatic urethra has begun the patient begins to feel mild symptoms which are either disregarded or attributed to incidents in the daily life, such as food, occupational activity or excessive drinking or sexual activity. In this premonitory stage or stage of mild irritation, prostatic congestion predominates with nocturnal urinary disturbances (dysuria and pollakiuria).

In a more advanced stage the local symptoms begin (difficulty and pain on micturition) which grow worse from day to day with repeated attacks of hypertonia of the sphincter, impossibility of emptying all the contents of the bladder (residual urine), polyuria, particularly at night, and symptoms of general exhaustion. The disturbances of bladder dynamics progress (hypertonia, hypotonia, even atony) to such a degree that frequently the patients have an attack of acute retention (functional impossibility of emptying the bladder) which is certain to be followed by infection. The aggravation of these symptoms results before long in inability to empty

the bladder spontaneously. Its musculature loses its capacity for contraction, becomes excessively distended, and complete retention begins. In some cases even in this period there is a slight contractile reaction on the part of the bladder and the urine regurgitates through the urethra, causing paradoxical ischuria. The excretory tracts and the kidneys having become involved, it is not long before insufficiency of the kidneys results, there are repeated attacks of pyelonephritis, and uremia and urosepsis complete the final picture of all these complications caused by adenoma of the prostatic urethra.

The patient may come to the general physician or the specialist in any of these stages of the disease. It is best to examine him in the early stage of the disease in order to make an accurate diagnosis both with regard to the clinical manifestations of tumor of the prostate and of the disease itself with its local and general disturbances and kidney complications. From this examination the therapeutic indications will be established, which may eventuate in surgical operation, either palliative, conservative or radical.

Our routine examination for a long time has been as follows:

(*a*) History of the symptoms which have aroused suspicion, together with anything indicating disturbances of the neck (the so-called dysectasias) or massive lithiasis of the prostate, or prostatitis.

(*b*) Digital exploration by the methods of Picker, Sellei, Fuller and Voelcker, Spencer, and others, which shows the size and consistency of the prostate, but which does not enable a diagnosis to be made of the middle lobe, of micro-adenoma in an atrophied prostate, of the ventral lobe, or even of differentiation between prostatitis, massive lithiasis of the prostate and adenoma in certain stages of its development.

(*c*) Exploration of the urethra (with a sound) which shows the length of the prostatic urethra, makes it possible for the examiner to feel the obstruction caused by a tumor of considerable size and supplies residual urine and material for the investigation of certain complications such as urinary infection, but is not sufficient for a complete examination.

(*d*) Urethrocystoscopy (instruments of McCarthy, Lowsley and Peterson, v. Lichtenberg, and others), which is dependent on permeability of the urethra and which gives a clear view of the protrusion of lobes of an adenoma into the enlarged and deformed prostatic urethra, of the middle and ventral lobes and of other complications and modifications resulting from the adenoma itself (pulsion diverticula, true diverticula, hypertrophy of the inter-ureteric torus, trabeculated bladder, inflammatory conditions, changes in the ureteral orifices, lithiasis of the bladder, etc.). But this method of examination does not give a clear picture of the pelvic localization of the tumor, it does not permit of differentiation between fibrosis of the neck and beginning hypertrophy of the middle lobe and it causes trauma, and hemorrhage. It increases the suffering of the patient in advanced stages and is impractical in large tumors in which it is accompanied by hemorrhage in spite of continuous irrigation, which makes false routes between the lobes of an adenoma developing in the membranous urethra, and in prostatics and patients with urinary infection frequently causes attacks of ascending pyelonephritis (trauma, reflux).

(*e*) Roentgen examination which until recently was restricted to roentgenography of the prostate with an opaque sound, to Burckhardt-Floerckern's aerocystography and to cystography with oily solutions or suspensions as a contrast medium which were sometimes irritating, but recently has included intravenous urography for the diagnosis of dynamic disturbances brought about by adenoma of the upper excretory passages and of the functional condition of the kidneys* (Fig. 5 and 6). Retrograde cystography almost always shows incidents in the development of the adenoma, such

* Sometimes the cystogram shows the size of a prostatic tumor which has extended into the bladder.

as pulsion diverticula, true diverticula and finally residual urine and the appearance of the paretic bladder.

Roentgenography is not concerned with demonstrating the different clinical forms of adenoma, as such determinations can be

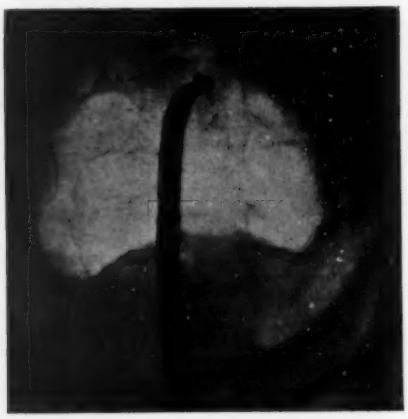

FIG. 5. Roentgenogram of the prostate with opaque sound. (According to Casper and Picard.)

FIG. 6. Aero-cystography in adenoma of the prostate. (According to Casper and Picard.)

made by cystography (with air, retrograde or intravenous urography). This accomplishment is due solely to retrograde urethrocystography, which shows the undeniable importance of roentgen examination of patients with adenoma of the prostate.[8]

Technique of Urethrocystrography.

The technique of urethrocystography according to the method described in a "preliminary note" before the Urological Section of the Paulist Medical Association, August 25, 1940, consists essentially of:

(*a*) Previous filling of the bladder for the purpose of showing its entire outline, particularly that of the basal portion; 60 to 80 cc. of the contrast medium is injected. The amount varies in the individual case of adenoma of the prostate, depending on the size of the tumor when previous routine examinations (palpation, exploration of the urethra, urethrocystoscopy) have already shown its size. When they have not, the first roentgenogram will indicate whether

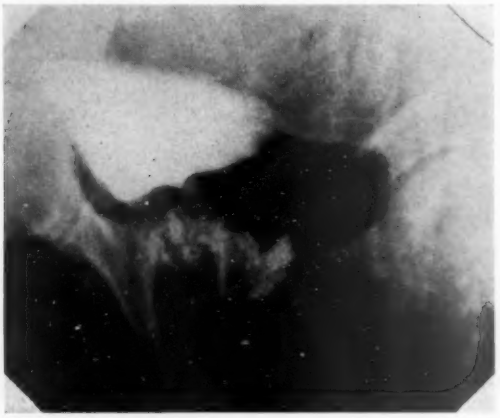

FIG. 7. Normal image of the neck. Dilated prostatic glands, prostatic urethra not elongated (profile roentgenogram).

it is necessary for the amount to be increased (in large adenomas growing into the bladder, for example). When, on the other hand, there is a large amount of residual urine, the bladder should be emptied before the contrast medium is injected.

(*b*) The filling of the whole of the urethra (15 to 20 cc. of contrast medium). For this purpose a syringe of 20 cc. capacity is used which is adapted for the purpose by using a rubber tip which occludes the opening of the urethra.

(*c*) A roentgenogram made exactly during the terminal part (10 cc.) of the urethral injection.*

* Based on the principle of cerebral arteriography of Egas Moniz.

Fig. 8

Fig. 9

Fig. 8. Urethrocystography in chronic prostatitis. Elevation of the base of the bladder by increase in the size of the prostate. Prostatic urethra without the changes of adenoma (profile roentgenogram).

Fig. 9. Urethrocystography in chronic prostatitis. Elevation of the base of the bladdder by increased size of the prostate. Prostate glands slightly dilated. Prostatic urethra not elongated (profile roentgenogram).

No force should be used. The injection should not be made too rapidly or too slowly. Otherwise the roentgenogram will not show a clear picture of the prostatic urethra nor a perfect image of the "internal sphincter."

Positions. For the purpose of systematizing the examination two positions are used: (*a*) lateral oblique, or semiprofile, and (*b*) anteroposterior or frontal. In the former the patient is placed in dorsolateral decubitus, preferably right, with the thigh flexed and in forced abduction with relation to the opposite leg which is extended. In the anteroposterior or frontal position the patient lies in dorsal decubitus. With the roentgen tube centered on the pubis the roentgenogram is made according to the requirements peculiar to each particular form of apparatus (milliamperage, exposure time, kilovoltage, which vary according to the thickness of the patient's body).

Contrast Media. There has been a great deal of discussion of the qualities of the various contrast media used in the examinations and of which are to be preferred (thorotrast, uroselectan, and perabrodil, lipiodol, 20 per cent neo-iodipin, 25 per cent sodium bromide, 15 per cent sodium iodide, suspension of reobarite, barium sulfate and 30 per cent citobarium); some of them dangerous, others irritating. We prefer a suspension of luxobarium,* prepared by the Spic Laboratory of Sao Paulo, because of its cheapness, ease of preparation, chemical harmlessness, opacity, and so forth. The suspension is prepared especially for us in the proportion of 60 gm. powder to 100 cc. boiling water.

Roentgen Diagnosis. When the two roentgenograms, profile and frontal, are obtained the roentgen diagnosis is made† (Fig. 7, 8 and 9). It is the urologist who is best fitted to make this examination and give the most accurate interpretation. He knows the history of the patient and has already certain preliminary examinations and knows the object of the examination and what is to be disproved or confirmed.

The points to be considered are: (*a*) the characteristics of the bulbar filling; (*b*) the form and relations of the membranous urethra to the adenoma; (*c*) the elongation, deformities, dilatations and angulations of the prostatic urethra (supra- and inframontanal); (*d*) the arrangement of the "internal sphincter" in relation to the bladder

* The base is barium sulfate.

† We refer here to the roentgen diagnosis of urethrocystography. It is well to remember that in cases in which cystoscopy is impossible an orienting roentgenogram precedes urethrocystography for the verification of lithiasis of the bladder.

Fig. 10. Miniature form of adenoma of the prostate (profile roentgenogram). Two small nodules developed intravesically. Atrophy of the prostate gland (seventy-four years).

image of the urethra is short, or not elongated, since this form of adenoma occurs in a prostate of normal size or even more frequently in a prostate atrophied by senile involution. Sometimes the tumor projects into the base of the bladder and into the supramontanal part of the prostatic urethra, and sometimes the small tumor nodule develops into the opening of the

Fig. 11

Fig. 12

Fig. 11. Outline of middle lobe (profile roentgenogram). Angulation of the prostatic urethra. Endoscopic appearance of fibrosis of the neck.

Fig. 12. Outline of middle lobe (frontal roentgenogram). Prostatic urethra not elongated. The lobe protruding between elevations of the prostate enlarged from prostatitis.

cavity; (*e*) the configuration of the elevations on the basal plane of the bladder; (*f*) the perfection, the clearness and the deformities of the outline of the bladder.

The roentgen diagnosis will be based on a minute observation of the above points.

It should be noted, however, that the characteristics of each segment examined vary with the stage of development of the prostatic tumor (adenoma) and its clinical form.

In the miniature form of adenoma the

Fig. 13. Solitary middle lobe (profile roentgenogram). Angulation of the prostatic urethra. The "internal sphincter" is directed forward, the nodule protruding into the bladder.

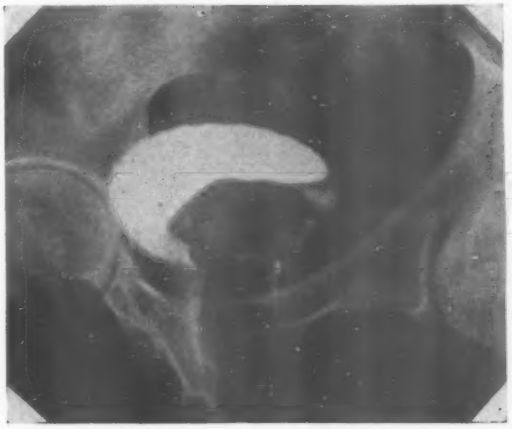

Fig. 14

Fig. 15

Fig. 14. Middle lobe grown to large size (profile roentgenogram). Notable angulation of the prostatic urethra.
Fig. 15. The same case as Figure 14 (frontal roentgenogram). The image of the prostatic urethra is interrupted at the point of angulation.

sphincter of the bladder neck (Fig. 10). In these cases roentgen examination is of great aid in the interpretation of the urethrocystoscopic examination.

Three patients with this form of adenoma of the prostate were examined. In 2 the nodule, localized on the right side, was shown in the frontal roentgenogram as a protuberance into the supramontanal part of the urethra. In 1 case it protruded into the base of the bladder in the profile roentgenogram.

In solitary middle lobe in the profile roentgenogram it is always to be noted that the "internal sphincter" is directed forward, the nodule protruding, in a characteristic manner, back of the "sphincter" into the base of the bladder and varying greatly in size (depending on the stage of development) (Fig. 11, 12 and 13).

The image of the urethra, not elongated, protrudes into the supramontanal portion, making an angulation which is larger, the greater the development of the adenomatous nodule (Fig. 14). If there are accompanying lateral lobules with a subvesical or even intravesical growth, there is a varying degree of elongation of the prostatic urethra, and it may even be deformed and enlarged in diameter.

In the anteroposterior roentgenogram the nodule can be seen protruding into the base of the bladder between the borders of the "internal sphincter." The image of the urethra, elongated, broadened and with or without deformity, often shows an interruption at the point of angulation (Fig. 15).

We diagnosed the existence of a middle lobe in 10 patients; in 5 it was solitary and in 5 associated with lateral lobes.

In 1 of the cases a roentgenogram taken farther laterally showed the lateral lobes with the middle lobe located between them.

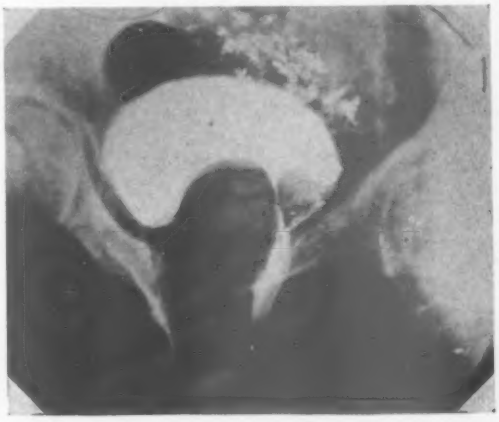

Fig. 16. Ventral or distal lobe (profile roentgenogram). Quite large intravesical growth of a tumor nodule. Extreme enlargement of the prostatic urethra.

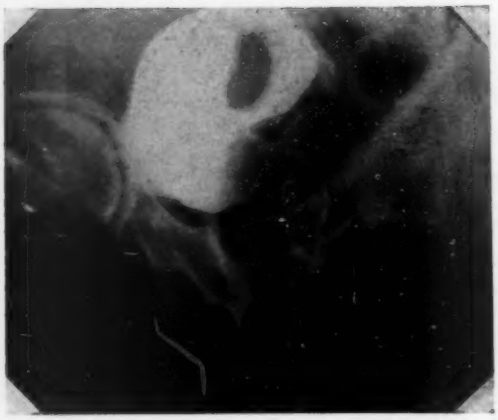

FIG. 17. Ventral or distal lobe (profile roentgenogram). Tumor growth partly intravesical and partly subvesical. Image of the prostatic urethra with the concavity forward. The subvesical part of the tumor growth reaches the membranous urethra, creating angular interstices, dangerous on instrumental examination. The roentgenogram shows the lacunar image of the accompanying bladder tumor (papilliferous cancer).

In the ventral or distal lobe, rarely seen, the "sphincter" is turned upward, the tumor nodule protruding into the base in front of the "sphincter" and with a volume that varies with the stage of growth (Fig. 16).

The image of the prostatic urethra, widened, elongated and deformed, sometimes shows a protrusion of the tumor into the lumen of the urethra (Fig. 17).

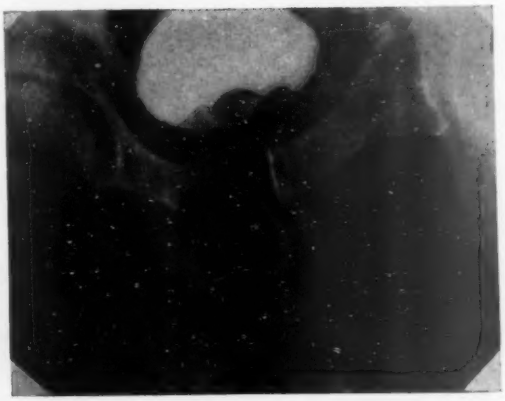

FIG. 18. Lateral lobes and middle lobe (profile roentgenogram). Intravesical protrusion of tumor nodules growing into the bladder. Angulation and enlargement of the prostatic urethra.

The protrusion corresponding to the edge of the posterior commissure of the neck projects more or less into the base, depending on the volume and growth of the ventral lobe. In total adenoma the lateral lobes in the profile roentgenogram project more or less into the base with equal or unequal growth of the two sides, the "sphincter" is turned upward, the image of the urethra is not elongated in the beginning but becomes increasingly elongated, broadened and deformed as the adenoma nodules increase in size (Fig. 18–28).

Sometimes the membranous urethra it-

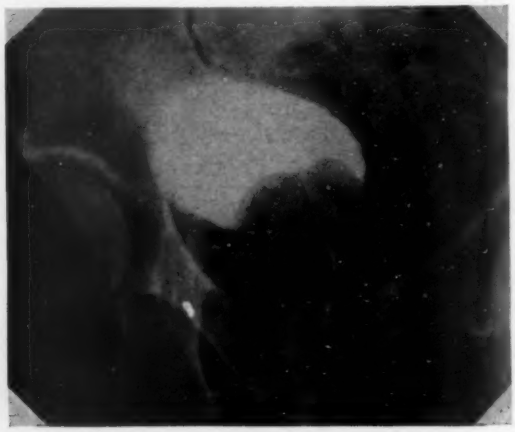

FIG. 19

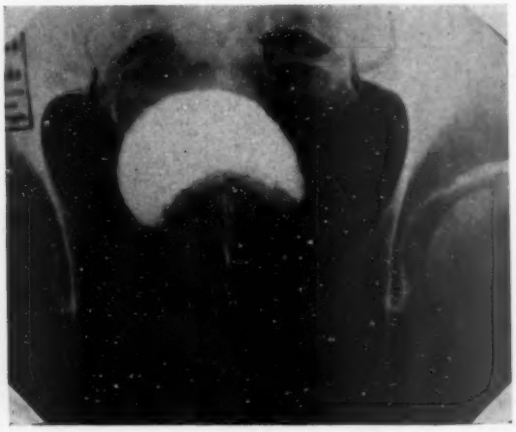

FIG. 20

FIG. 19. Total adenoma (profile roentgenogram). Intravesical growth of tumor. The prostatic urethra elongated and enlarged, the "sphincter" in the upper part of the tumor.

FIG. 20. The same case as Figure 19 (frontal roentgenogram).

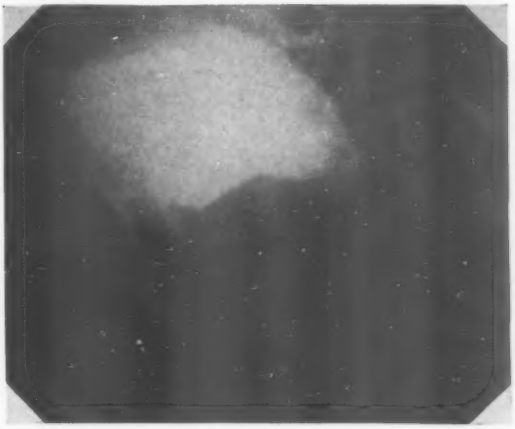

Fig. 21 Fig. 22

Fig. 21. Total adenoma (profile roentgenogram). Intravesical protrusion of the tumor, but greater subvesical development.

Fig. 22. The same case as Figure 21 (frontal roentgenogram).

self becomes deformed with the subvesical growth of the adenoma and shows interstices which make instrumental examination dangerous; and in advanced stages the protrusion of the tumor reaches to the terminal part of the bulbar urethra.

In the frontal roentgenogram the image of the tumor protrudes into the base, the size varies depending on the stage of development and it may be subvesical or intravesical or partly subvesical and partly intravesical.

The image of the prostatic urethra is broadened, elongated and deformed, or is represented by a narrow thread of contrast medium due to the filling of the lumen by the tumor masses.* The roentgen appear-

* In the neighborhood of the "internal sphincter" it may bifurcate, showing that the contrast medium passes into the interstices of the tumor.

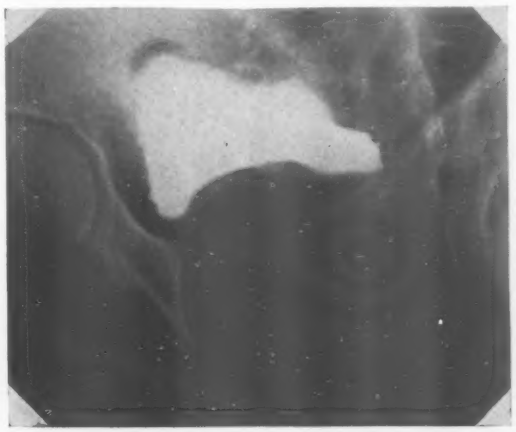

Fig 23 Fig. 24

Fig. 23. Total adenoma (profile roentgenogram). Though the tumor protrudes into the bladder cavity the greater part of the growth is subvesical.

Fig. 24. The same case as in Figure 23 (profile roentgenogram). The cystogram shows signs of paresis of the bladder (attacks of retention) at the apex of the bladder.

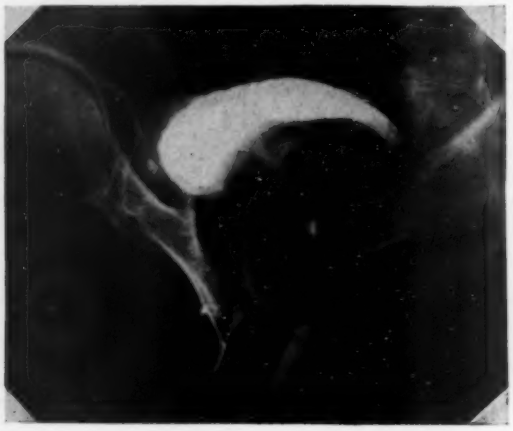

Fig. 25

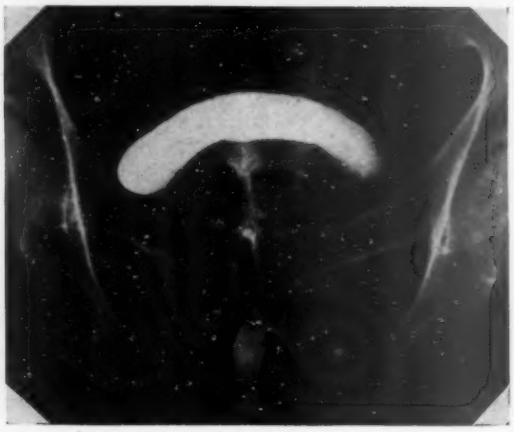

Fig. 26

Fig. 25. Total adenoma (profile roentgenogram). Large tumor with both intravesical and subvesical growth. The tumor in its growth has obstructed the prostatic urethra. The contrast medium has passed into the interstices in the tumor nodules.

Fig. 26. The same case as in Figure 25 (frontal roentgenogram).

ance depends, however, on the stage of development of the tumor.

In the 18 cases of this form of adenoma examined, we demonstrated the different stages of development from small adenomas of the lateral lobes to total adenomas and those of excessive development, some even with changes in the membranous and bulbar urethra. In many of these examinations the outline of the bladder showed changes caused by the adenoma, such as pulsion diverticula, true diverticula and a lacunar image corresponding to the bladder tumor (Fig. 17, 27, 29 and 30).

Findings in Urethrocystography. Though these unusual examinations were ordinarily carried out by skilled technicians there were a number of occurrences which deserve attention:

(*a*) Slight breaks in the mucosa of the

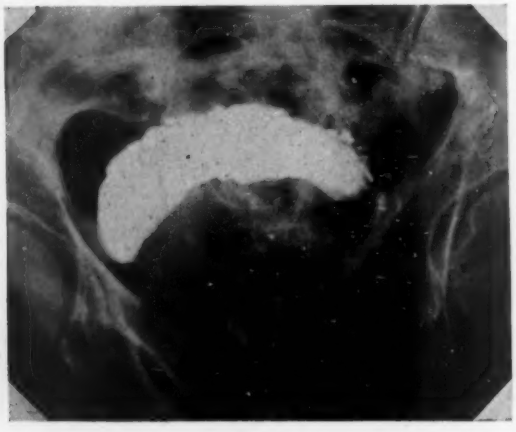

Fig. 27

Fig. 28

Fig. 27. Total adenoma (profile roentgenogram). Tumor of very large size. Intravesical and subvesical growth. Great elongation of the prostatic urethra which is filled with tumor nodules.

Fig. 28. The same case as in Figure 27 (frontal roentgenogram). The cystogram shows numerous pulsion diverticula.

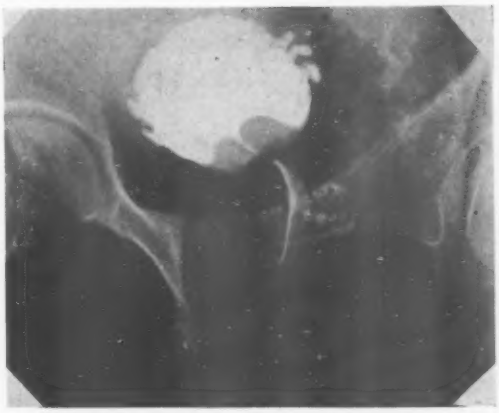

Fig. 29. Total adenoma (profile roentgenogram). Tumor with subvesical growth. Angulation, enlargement and elongation of the prostatic urethra. Prostatic glands dilated. Neck shows typical image of hypertonia of the sphincter. The cystogram shows pulsion diverticula.

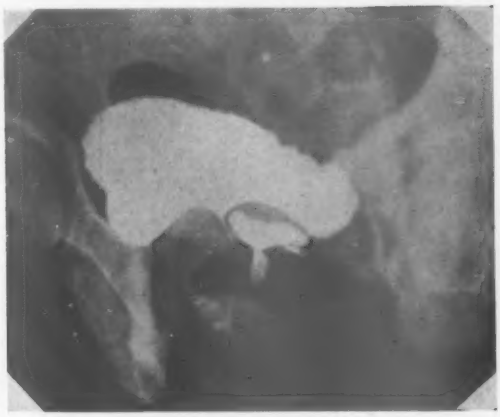

Fig. 30. Total adenoma (profile roentgenogram). Tumor of subvesical growth with abscess cavities. Part of the tumor projects into the bladder cavity.

prostatic urethra from distention during the filling. The patient passed contrast medium stained with blood. The mucosa, congested from stagnation or inflammation, suffered ruptures of the small vessels which made them bleed.

(*b*) Obstruction of the penetration of the contrast medium into the prostatic urethra when it was obstructed by growth of the tumor masses into it.

(*c*) Subadenomatous fissuring and loss of blood when a subvesical adenoma projected into the membranous urethra and enlarged it. The wave of liquid distended the interstices and fissured them.

(*d*) Fissuring of the bulbar cul-de-sac and loss of blood from its distention in large subvesical adenomas.

(*e*) Even rupture of the bulbar cul-de-sac, involving the bulbar vein with penetration of contrast medium into the pudendal vein, reflux by the dorsal veins of the

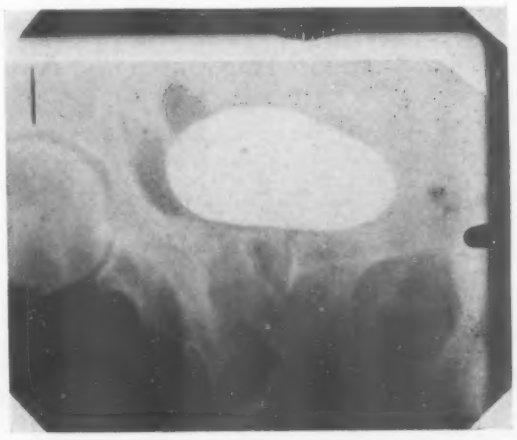

Fig. 31

Fig. 32

Fig. 31. Congenital atrophy of the neck (profile roentgenogram). Atrophic prostate. (Plane image of the neck.)

Fig. 32. Sclerosis of the neck (inflammatory). (Profile roentgenogram.) Chronic prostatitis, stricture of the urethra, perineal fistulas. Suprapubic drainage (plane image of the neck).

penis and the dorsal emissary veins, penetration into the internal pudendal vein and impregnation of Santorini's plexus (urethrovenous reflux). Danger of hemorrhage, embolism, infection and generalized sepsis.

(f) Reactivation of latent inflammatory processes in the prostate and vesicles as well as reactivation of attacks of pyelonephritis in prostatics with urinary infection.

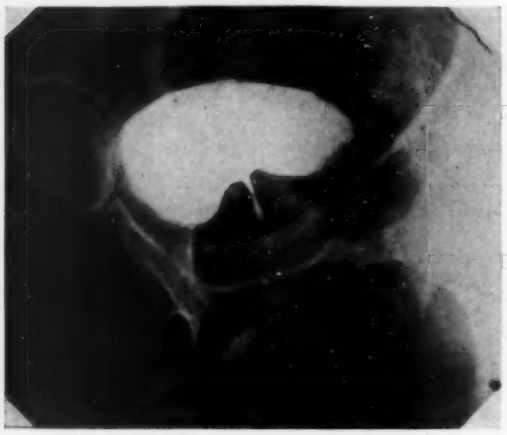

FIG. 33

FIG. 34

FIG. 33. Hypertonia of the sphincter (profile roentgenogram). Chronic adnexitis with subacute exacerbations (typical fish-mouth image).

FIG. 34. Fibrosis of the neck (profile roentgenogram). Hypertrophy of the trigonal muscle. (Typical image.)

Among 31 patients with adenoma of the prostate on whom urethrocystography was done we observed the following:

Bleeding of the urethra from rupture of the mucous membrane	6
Reactivation of latent inflammatory processes of the prostate and vesicles	1
General depression after the examination	2
Reactivation of attacks of pyelonephritis in prostatics with urinary infection	2
	13

Among the remaining 18 patients examined there were no special findings. And particularly in nearly 100 cases of urethrocystography (stricture, ectasias of the neck, adenoma, etc.), there was never any urethrovenous reflux.[7,8]

Contraindications. There are, however, contraindications to urethrocystographic examination in the diagnosis of adenoma of the prostate which may be summarized as follows:

(*a*) When there is recent trauma resulting from instrumental examination, with or without loss of blood (danger of reflux and its sequels).

(*b*) In adenoma patients with acute or recent gonorrhea.

(*c*) In the course of subacute adnexitis (prostatovesiculitis) in patients with adenoma of the prostate.

(*d*) In the course of treatment of abscess of the prostate, particularly if it opens into the urethra, in patients with adenoma.

CONCLUSIONS

From the number of cases (31) examined of patients with adenoma of the prostate in all its clinical forms we conclude that urethrocystography as carried out by us is necessary and even indispensable in the examination of these patients for the following reasons:

(*a*) It gives the global or topographic appearance of adenoma of the pelvis.

(*b*) It shows accurately the forms of clinical manifestation (miniature form, median lobe, ventral lobe, lateral lobes, total adenoma) as well as the forms of its further development (vesical, subvesical).

(*c*) It shows the relation between an adenoma with subvesical growth and the parts of the membranous and bulbar urethra, giving a warning of the dangers of instrumental examination in these cases.

(*d*) It permits of differential diagnosis between adenoma and dysectasias of the neck (congenital atrophy, sclerosis, fibrosis of the neck and hypertonia of the sphincter (Fig. 31, 32, 33, 34).)

(*e*) It makes possible a better choice of the method of treatment for each of the clinical forms (suprapubic and perineal operations, endoscopic resection).

(*f*) Finally, it permits of verification of postoperative incidents and complications (structural deformities) which would retard clinical cure of the patients operated on, and shows recurrences of the tumor.

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METASTASIS TO BONE AS THE FIRST SYMPTOM OF CANCER OF THE GASTROINTESTINAL TRACT*

REPORT OF THREE CASES

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A REVIEW of the literature reveals that although metastasis to bone from cancer of the gastrointestinal tract occurs more frequently than is generally realized, cases in which the bone lesion produces the first symptom of these cancers are quite rare.

The 3 cases here presented sought relief from the symptoms caused by the bone involvement, none of whom had any important symptoms referable to the gastrointestinal tract. A biopsy revealed the true nature of the tumors, and in each instance the pathologist, Dr. A. R. Camero, suggested the probable source of the bone lesions. Gastrointestinal roentgen studies were made only after the pathological diagnosis of adenocarcinoma had been made and, in each case, the primary growth was found in the gastrointestinal tract: 1 in the stomach and 2 in the sigmoid colon. Metastasis to the regional lymph nodes and to the surrounding and neighboring organs is frequent, but judged by our own experience and by the records in medical literature, distant bone metastasis from cancer of the digestive tract is relatively uncommon so far as it is found clinically even after the primary lesion has been discovered. Many of these cases are undoubtedly missed because it is usually not practical to make a complete roentgen examination of the entire osseous system unless there is a suspicion or sign or symptom suggesting bone involvement. The pathologist, no doubt, also fails to recognize a number of these cases because the usual autopsy on patients dying from gastrointestinal cancer does not include a detailed study of the skeletal system.

Our 3 cases were discovered in a series of 186 patients with carcinoma of the gastrointestinal tract over a period of ten years (1932 to 1941): 13 in the esophagus, 75 in the stomach, and 98 in the colon and rectum.

Recently Buirge,[4] in a report on carcinoma of the large intestine, reviewed 416 autopsy records, finding 31 per cent of this number incorrectly diagnosed. Sixteen per cent of the cecal lesions were diagnosed appendicitis and 8.3 per cent as cholecystitis. Recent hemorrhoidectomies had been performed on 5.2 per cent of the cases, without discovering the primary lesion in the sigmoid or rectum. It is a well known fact that the early symptoms of cancer of the colon may be of such a vague and insignificant nature, or even absent, that both the patient and the physician may be misled and the diagnosis made only after the occurrence of distant metastases. In a series of 391 autopsies on patients with primary neoplasms of the digestive tract, Turner and Jaffe[22] found 7.9 per cent with bone involvement. Rendich and Levy[18] report 6 unusual cases of bone metastasis, 2 of which were secondary to gastrointestinal carcinoma. These 2 cases are similar to my own in that the chief complaint was caused by the distant bone metastasis rather than the primary growth, and in 2 instances the secondary growths were found below the knee. Nisnjewitsch[17] reported 6 instances of bone metastasis, found at postmortem, in 57 cases (10.5 per cent) of primary carcinoma of the rectum. Mathews[14] found an incidence of 2.5 per cent of bone involvement from gastric cancer. Moore[15] found, in his study of 1,600 cases of carcinoma of the stomach, no evidence of bone involvement. Jenkinson,[10] in his series of gastrointestinal cancer giving rise to bone metastasis, found no tumors secondary to carcinoma of the stomach, but found a record of 41

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cases in the literature in which the metastasis occurred from different parts of the gastrointestinal tract. Warwick[24] reports metastasis to bone in 4 out of 176 autopsy cases of gastric carcinoma, or 2.2 per cent. Aufses[1] reviewed a series of 117 cases of rectal carcinoma and found 8 instances of bone involvement, or 6.8 per cent. In his series of 537 cases of carcinoma of the stomach, from Johns Hopkins Hospital, Copeland[6] reports 7 cases with bone lesions, or 1.3 per cent. Sutherland[20] states that 1.9 per cent of his 1,032 cases of malignant bone metastasis arose from primary growths in the stomach. Warren[23] found 5.7 per cent of bone involvement in his gastric cases, and also reported 2 cases with bone involvement in 156 cases of carcinoma of the colon. Willis[25] reports the incidence of skeletal metastasis from carcinoma of the stomach as approximately 5 per cent. In 1935, Kerr and Berger[11] reviewed the literature, finding 143 cases and added 5 of their own. In his series of 606 cases of gastric carcinoma, Lawton[12] reports only 3 with bone involvement. Clayton[5] in 41 cases of carcinoma of the esophagus, found 2 cases with bone metastasis. Ghormley and Valls[8] surveyed the records of cases in which a diagnosis of carcinoma of the gastrointestinal tract was made at the Mayo Clinic in the fifteen year period from 1922 to 1936. The growths occurred in the esophagus, stomach, duodenum, jejunum, colon, sigmoid, rectosigmoid, and rectum. The greater number of cases of metastasis to bone from carcinoma of the rectum and stomach, they thought, was due to the greater incidence of carcinoma in these organs. Only 1 case of bone metastasis from small bowel carcinoma was found. The accompanying table shows the distribution and location of bone metastases in their 43 reported cases (Table 1). The table indicates that most skeletal metastatic growths are in the bones of the trunk; that is, in the vertebrae, the pelvis and the ribs. In only 6 cases were long bones involved. This distribution would be expected because bone metastases from most types of carcinoma have a similar distribution. Most of the reported cases show the majority to be osteolytic although osteoblastic lesions also occur. When the metastases are osteoblastic and associated with carcinoma of the rectum, primary prostatic involvement must be suspected. The destruction of bone and bone marrow may be very extensive, producing a blood picture strongly suggesting pernicious anemia. Markowitz[13] reports such a case in which the erythrocyte count was 1,010,000; hemoglobin, 18 per cent; color index, 1.1 The postmortem examination showed adenocarcinoma of the stomach

TABLE I

DISTRIBUTION AND LOCATION OF BONE METASTASES IN 43 CASES (GHORMLEY AND VALLS[8])

Location	No.	Secondary Growths							Incidence of metastasis to bone from all carcinomata of the indicated organs (per cent)
		Location							
		Spine	Pelvis	Ribs	Long bones	Sternum	Scapula		
Esophagus	1			1				1	0.2
Stomach	12	6	3	5	2	1		17	0.2
Small bowel	1	1						1	
Colon	3	1	1	1				3	
Sigmoid	3	2		2	1			5	0.3
Rectosigmoid	4	3	2					5	
Rectum	19	6	8	1	3		1	19	0.5
Total	43	19	14	10	6	1	1	51	

with extensive bone metastasis. The first symptom in his case was pain in the legs and rapidly progressing anemia with no special gastrointestinal symptoms. Barclay[2] reports a case of colloid carcinoma of the stomach, the first symptom being a pathological fracture of the clavicle while turning in bed. No gastrointestinal study was done, there being no symptoms referable to this tract. Roentgen examination revealed a generalized carcinomatosis involving practically all of the bones of the body including the extremities. The site of the primary lesion was not determined. The erythrocyte count was 1,500,000; hemoglobin, 33 per cent; color index, 1. No gastrointestinal symptoms developed until shortly before death. Stein,[19] in his series of 1,005 cases of carcinoma of the digestive tract, reports 34 with bone metastasis. In this series he includes carcinoma of the pancreas, gallbladder and biliary ducts, one of which was the result of primary carcinoma of the small bowel. Fort[7] also reports a single case of bone metastasis from carcinoma of the small bowel. Tilling[21] reported a case in which a metastatic growth in the humerus was the first sign of gastric cancer. Müller[16] studied the records of 12,730 postmortem examinations performed at Basle Pathological Institute from 1817 to 1905. His findings are shown in Table II. The high incidence (12.09 per cent) is in part explained by the fact that his studies were limited to postmortem material.

TABLE II

POSTMORTEM FINDINGS

Location of Primary Carcinoma	No. of Cases	Cases with Metastasis to Bone	
		No.	Per cent
Stomach	309	8	2.58
Esophagus	101	7	6.93
Rectum	57	6	10.52
Gallbladder	56	2	3.57
Pancreas	19	4	21.05
Liver	15	3	20.00
Pharynx	10	2	20.00
Total	567	32	Av. 12.09

Müller studied the records of 12,730 postmortem examinations performed at Basle Pathological Institute from 1817 to 1905 and found 567 cases of carcinoma of the gastrointestinal tract.

The principal recognized methods of spread of malignant metastasis are: lymph and blood borne emboli, lymph and blood vessel permeation, and various combinations of these routes. Gray[9] has recently shown that the spread of cancer by lymph vessel permeation is less common than is generally supposed. Batson[3] has demonstrated by experimental work on the cadaver and monkeys the probable route by which many distant metastases occur. We have all seen metastatic tumors appear in locations that do not seem to be in line of direct spread from the primary focus. Batson injected radiopaque material into the dorsal vein of the penis. The material did not enter the inferior vena cava but progressed up the spine. Many intercostal veins were filled as well as the veins of the pelvis. When the amount of the injection was 200 cc., the material reached the base of the skull and entered the cranial cavity. It also extended down into the thigh, through fine straight vessels. Valves prevented the filling of the larger veins of the thigh. These experiments were repeated on living monkeys with the same distribution of the injected material. Batson has demonstrated that the entire system of epidural and vertebral veins has a free anastomosis at each spinal segment with the veins of the thoracic and abdominal cavities. It is a system of veins without valves, except in minor connecting channels, and with very low pressure. With every compression of the trunk such as occurs by coughing, lifting and straining, the intratruncal pressure is raised to a sufficient height so that blood flows, not into the inferior vena cava, but into this vertebral system of veins. He believes that many distant metastatic lesions may occur through these veins without involving the portal, pulmonary or caval system. This method of spread could very well account for the distant isolated bone lesions produced in our cases: one from the sigmoid colon to

the skull; one from the sigmoid to a rib, and one from the stomach to the left fibula. The routes and methods of dissemination of malignant emboli are so varied and extensive that it is not possible to anticipate the probable location of their development. Very distant lesions may be produced without any demonstrable intervening metastatic involvement. For these reasons it is practically never possible for the surgeon or anyone else to determine with any degree of certainty the curability of cancer of the gastrointestinal tract regardless of its duration, size, location, mobility or any other of its many varied qualities or characteristics.

CASE REPORTS

Case 1. A female, aged fifty-seven, white, well nourished, was referred to the Misericordia Hospital on October 11, 1939, as an ambulatory patient for the removal of a "sebaceous cyst" from the scalp. About four weeks ago she noticed a sore spot in the left temporal region. A lump developed in this area which gradually increased in size, until now there is a rather hard, fixed, reddish tumor about 2 cm. in diameter, located at the hair line in the left frontal region. Under local anesthesia an incision was made and immediately it was recognized by the surgeon that this was not a "cyst," but a tumor which had already involved and destroyed a considerable area of the frontal bone. Most of the soft tissue mass was removed and sent to the laboratory.

Pathological Report. "The histopathologic picture here seen is typically that of adenocarcinoma and from its appearance it is apparently a metastatic lesion. In the better differentiated portions the appearance of the epithelial tumor cells suggests the large bowel as the primary site but we cannot be sure of this."

The patient was then admitted to the hospital for extensive studies. She has been feeling entirely well and had no complaint except for an occasional pain in the region of the recently excised tumor. Her appetite has been good and she has had no gastrointestinal complaints of any kind; no abdominal pain, nausea or vomiting. Bowel function has been entirely normal.

Physical examination revealed nothing of importance except the lesion in the left frontal region.

Laboratory Findings. Erythrocytes, 4,250,000; hemoglobin, 84 per cent; leukocytes, 7,500. Urine negative for casts, sugar and albumin.

Fig. 1. Case 1. Roentgenogram made through bandages immediately after the attempt to remove the supposed "sebaceous cyst," showing the destructive metastatic lesion in the left frontal bone. October 11, 1939.

Roentgen Findings. In a roentgen examination made on October 11, 1939, the skull shows an irregular area of bone destruction, approximately 5 cm. in diameter, involving the left frontal bone. The nature of this lesion cannot be determined from this study, but the irregular margin associated with the soft tissue tumor suggests possible metastatic malignant disease (Fig. 1). The neck, chest, spine and pelvis are normal in appearance. Gastrointestinal examination shows the stomach normal. In the colon there are many large, saccular diverticula and a constant constriction in the sigmoid, shown on several roentgenograms. This slight deformity could readily be produced by the diverticula and associated colitis, but if the abdomen is opened this area should be carefully examined for a possible small annular carcinoma. From the appearance alone an inflammatory lesion is favored, but in the light of the biopsy, carcinoma must be considered. Several roentgenograms were made of the filled colon on two different occasions and several after the double contrast enema, all of which show the same constriction (Fig. 2).

Operation (November 8, 1939). Under spinal anesthesia the sigmoid was exposed and freed. A small hard mass was identified and about 12 cm. of the sigmoid was resected. An end-to-end anastomosis was performed. The liver was then palpated and found to be studded with many

FIG. 2. Case 1. Roentgenogram of colon shows persistent constriction near the middle of the sigmoid, proved by resection to be a small adenocarcinoma. Multiple large diverticula are also present.

nodules about the size of an olive. A small incision was made in McBurney's point, and a cecostomy performed.

Gross Pathological Description. Specimen consists of 11 cm. of resected sigmoid. At about the middle of this specimen there is partial constriction of the lumen. On the mucosal aspect a small circular ulcerative tumor is noted which measures 1.5 cm. in diameter. This tumor has firm, everted margins and its base is quite firm. Several saccular diverticula are also noted, the orifices of which are quite narrow.

Microscopic Examination. The tumor is made up of large irregular masses of anaplastic epithelial tumor cells, arranged in very haphazard glandular formations, and separated by abundant dense fibrous connective tissue stroma. The cells show the various cytologic features of rapid growth, including some mitoses. Tumor tissue is seen to extend deeply into all layers of the bowel wall. Diagnosis: primary adenocarcinoma of the sigmoid.

The patient made a good recovery from the operation and remained fairly well until January, 1940, when vomiting, loss of appetite, loss of weight, jaundice and abdominal distention developed. From November 6, 1939, to January 25, 1940, the patient received 4,165 roentgens (125 kv., 6 mm. Al filter) over the skull lesion, but the tumor continued to increase in size until it involved an area 10 cm. in diameter, with almost complete destruction of the left half of the frontal bone. Other small scattered destructive lesions were found in the skull at this time (Fig. 3 and 4). The patient died on April 15, 1940, a little more than five months after the operation.

CASE II. This patient, white, female, aged seventy, was admitted to Misericordia Hospital November 22, 1940, because of pain and swelling in the left leg which began about three months ago. She consulted a physician soon after the onset of pain and was advised to stay

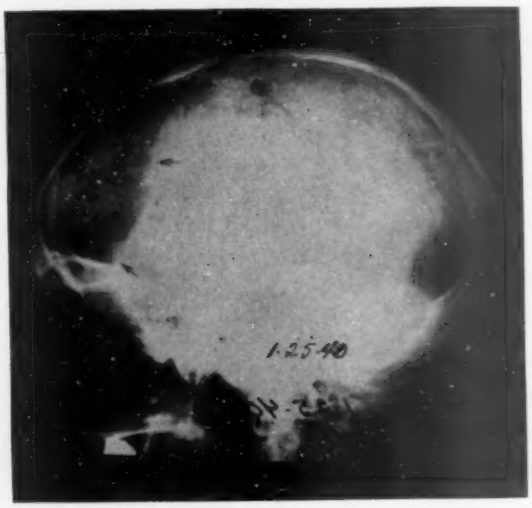

FIG. 3. Case 1. Left lateral view of the skull showing increase of destruction in the left frontal bone. January 25, 1940.

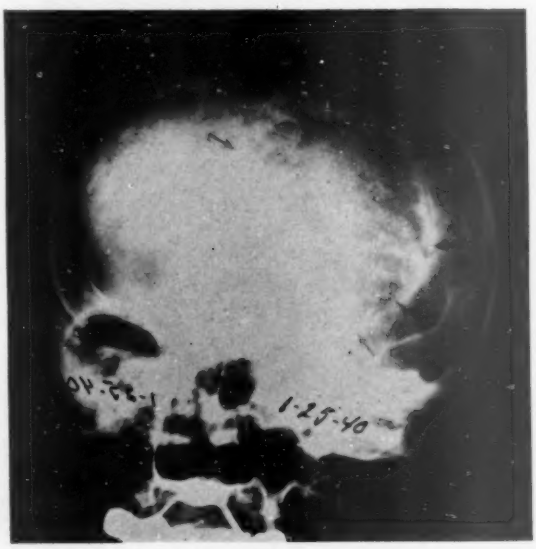

FIG. 4. Case 1. Oblique frontal view also made on January 25, 1940, showing large osteolytic lesion in left frontal bone.

off her feet as much as possible. She obtained no relief and was then admitted to the hospital. General health was good. She had an appendectomy performed at another hospital three months ago.

Physical Examination. Head, neck and chest grossly negative. Abdominal scar of recent appendectomy; no areas of tenderness or rigidity; no organs or masses palpable; abdominal skin lax and atrophic. *Extremities:* Patient complains of pain in left leg and over the tarsal bones of the left foot. There is present a palpable tumor in the outer portion of the left leg, just below the knee, and popliteal pulsation. No loss of temperature and varicose veins are present from the knee to foot.

Roentgen Findings. The left leg and ankle show a destructive lesion involving the upper 8 cm. of the fibula, except for a small portion of its upper extremity. There is complete destruction of the bone in this area. The bone immediately adjacent to the lesion is normal in structure. We have, therefore, a purely osteolytic lesion with no tendency to bone production or periosteal reaction. The appearance is strongly suggestive of solitary myeloma (Fig. 5). Roentgenograms of the skull, chest, spine, pelvis and right knee show no similar lesions. On the basis of these findings the upper third of the fibula was resected.

Laboratory Findings. Urinalysis negative for sugar, casts, albumin and Bence-Jones protein. Blood Wassermann and Kahn reactions negative. Erythrocyte count, 3,720,000; hemoglobin, 67 per cent; leukocyte count, 6,000; serum calcium, 11.

Microscopic Examination. Tissue submitted shows the characteristic picture of adenocarcinoma. After the pathological report a gastrointestinal roentgen examination was made and this shows a large, irregular filling defect, about 2½ inches in extent, involving the cardiac end of the stomach. There are also present two sharply defined transparencies along the greater curvature, suggesting polyps (Fig. 6). There can be little doubt that the metastatic lesion in the left fibula developed from the primary carcinoma of the stomach. Metastasis occurring below the elbow and knee, from primary carcinoma in any organ of the body, is uncommon but from carcinoma of the stomach such lesions must be very rare.

Case III. This patient, a white, fairly well nourished female, aged fifty-one, was admitted to the surgical ward of Misericordia Hospital, November 25, 1940. About two months ago the patient first noticed a lump in the left side of her neck. She has lost about 12 pounds in weight in the past four years. During the past five years

Fig. 5. Case II. Upper two-thirds of left leg showing metastatic osteolytic lesion in upper fibula.

Fig. 6. Case II. Large primary adenocarcinoma in cardiac end of stomach and two polyps along greater curvature.

she has passed blood in her stools several times. No urinary symptoms or gastric distress. Erythrocyte count, 4,750,000; hemoglobin, 74 per cent; leukocyte count, 8,600.

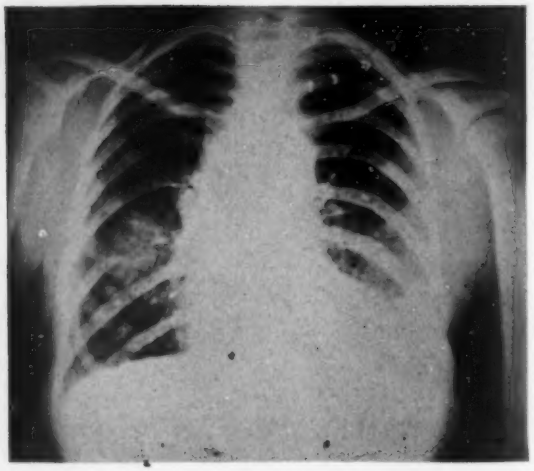

FIG. 7. Case III. Metastatic lesion in the eighth right rib, posteriorly, and soft tissue tumor which replaced the destroyed bone. Disease also in left base.

The patient presents a nodular mass in the left supraclavicular region about the size of a plum. The clinical impression was benign adenoma of the thyroid gland; lymphoma; lymphosarcoma.

On November 26, 1940, an incision was made over the mass and several large lymph nodes were identified. These were removed and sent to the laboratory. The same afternoon a roentgenogram of the chest was made which shows a destructive lesion involving about 3 inches of the eighth right rib posteriorly. The destroyed portion of the rib is replaced by a soft tissue mass. The nature of the osteolytic lesion cannot be determined from this examination (Fig. 7).

Microscopic Examination. Examination of the firm, matted lymph nodes shows the normal architecture almost completely destroyed and replaced by tumor elements consisting of large, irregular masses of anaplastic epithelial tumor cells arranged in haphazard glandular formations, and separated by abundant dense fibrous tissue stroma. The histopathologic picture seen here is typically that of adenocarcinoma, apparently metastatic. The appearance of some of the tumor cells suggests origin from the stomach or other part of the gastrointestinal tract. Barium studies were then made. The stomach and duodenum appear normal. The colon shows a persistent irregular filling defect at the junction of the descending and sigmoid portions, involving an area about 2½ inches in extent, reducing the lumen to about 0.75 cm. in diameter. The appearance is strongly suggestive of carcinoma of the sigmoid (Fig. 8). Although in this case the patient sought relief from the enlargement in the left side of the neck, the metastatic lesion in the eighth right rib was found before the primary tumor in the sigmoid was suspected or discovered.

DISCUSSION

The 3 cases here presented emphasize the difficulties in making a diagnosis of cancer of the gastrointestinal tract while it is still operable. In Case III an earlier diagnosis might have been made if the bleeding from the rectum, which occurred at intervals over a period of five years, had been carefully investigated. In Cases I and II, however, there was nothing in the histories or examinations to even suggest the presence of deep-seated malignant disease. In Case III the metastatic lesion of the rib was absolutely painless at the time the chest roentgenogram was made. Pain and tenderness, however, did develop in the back and lower right chest eleven days after dissection of the enlarged glands in the neck. The bone lesions in the other 2 cases were moderately painful and showed definite tumor formation. Cancer of the digestive tract was not suspected in any of the 3 cases, and the probable location of the primary growth was indicated by the microscopic examinations.

FIG. 8. Case III. Primary adenocarcinoma of the sigmoid. (Circle over lesion is due to aluminum compression cup.)

The literature reveals a considerable number of cases of bone metastases from gastrointestinal carcinoma, but only a few cases in which the primary tumor was located from the study of the metastatic lesion in the bone. There can be no doubt that a considerable number of these cases go unrecognized because few, if any, roentgenologists routinely roentgenograph all the bones of the body in conjunction with barium studies. At postmortem, too, it is not practical to study the entire skeleton in great detail in the absence of a definite bone lesion. The size of the lesion has little or nothing to do with determining the presence or absence of metastasis. In Case 1, the growth in the sigmoid was only 1.5 cm., and the metastatic deposit in the skull 5 cm. in diameter.

CONCLUSIONS

(1) Cancer may be present in the gastrointestinal tract for a considerable time without producing significant digestive disturbances.

(2) Bone metastasis from cancer of the digestive tract is more common than is generally realized.

(3) Bone metastasis as the *first sign* of gastrointestinal cancer is quite rare.

(4) More thorough skeletal roentgen and postmortem examinations would undoubtedly reveal a greater number of cases.

(5) Metastatic lesions in bone may attain considerable size before producing pain or any other symptom.

(6) The three cases here presented show purely osteolytic lesions.

(7) The route by which distant metastasis frequently occurs is probably through the "vertebral veins" (Batson).

(8) In our single treated case, roentgen therapy had no effect on the superficial soft tissue tumor or the bone lesion. The destruction of the skull and tumor of the scalp continued to progress until death.

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DISCUSSION

DR. GEORGE E. PFAHLER, Philadelphia. Many years ago the Emperer of China called together his greatest philosophers and asked them to formulate in the fewest possible words a philosophy that would fit all occasions, and finally after much deliberation they came back with three words or a sentence of three words—"It will pass." You will see that those three words do cover everything that we can think of.

Ross Golden has given us a gem in the introduction to his fine piece of work, the Nelson loose-leaf diagnostic book, when he said that the first essential in making a diagnosis is to think of it. In other words, you must think of the diagnosis before you can possibly make it. We can therefore summarize, as a philosphical point, our troubles in diagnosis by again boiling down the advice into three words, "Think of it." That is what Dr. Bertin has emphasized this morning in presenting these three cases. He has made us think of the possibility of a lesion that is found in an unusual place as being due to a metastatic cancer secondary to the gastrointestinal tract.

It is true that not many cases are recorded. I think Dr. Bertin has found only two other cases of this type in the literature. I have been doing gastroenterology for thirty-seven years. I have never come across any such case preceding these three which Dr. Bertin and I observed together at the Misericordia Hospital, but there probably are other cases and if we get into the habit of thinking of this, we will probably find others.

Dr. Bertin has referred to a case in which the first symptoms were due to metastatic nodules in the neck. That reminds me of a case that was brought to the Graduate Hospital with a recurrence after two operations for adenocarcinoma on the left side of the neck. The primary lesion was not found. I did not think of a gastrointestinal origin, and by very careful examination—and this patient had been examined repeatedly by the laryngologist—no lesion was found, but by palpation I found a small lesion, less than 0.5 cm. in diameter in the tonsil, which was found to be the primary lesion in that case. So we must think of these various possibilities, and it isn't only the gastrointestinal tract that we must think of, but Dr. Bertin has added this as another real contribution to make us think of hunting more thoroughly for the primary lesion.

The unusual distribution of the metastatic carcinoma as described in the paper by Dr. Bertin can probably be explained on the basis of distribution through the valveless venous channels as described by Batson, and as stated in his remarkable demonstration in our scientific exhibit made for this Society a year ago. He has shown that metastatic cancer cells can enter the venous channels and be distributed along the spinal veins as far as the head, and also into the venous channels of the lower extremities. Batson has illustrated the mode of dissemination of disease by calling our attention to the metastasis as found in biliary tuberculosis in which the disease is scattered through the arterial blood streams and distributes the multiple foci at random. In erysipelas, organisms invade a plexus of lymph vessels and multiply. As a result, the primary lesion enlarges, colony-like, from its margins. In tuberculous adenitis, the organisms spread in lymph channels to multiply in the regional lymph nodes and lymph node chains. These methods of distribution of metastatic cancer are also found and have been well recognized in the past, but Batson has described the fourth method by which the cancer cells are distributed and disseminated through the valveless venous system. It is entirely likely, therefore, that this is the explanation of the distribution of the lesion that occurred in the frontal bone, the one in the leg, while in the remaining or third case the deposit was probably distributed directly through the lymph channels, and implanted in the supraclavicular region.

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NEUROFIBROMATOSIS OF BONE*

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NEW YORK, NEW YORK

NEUROFIBROMATOSIS (Recklinghausen's disease[22]) was originally thought to be a disease of the peripheral nervous system characterized by the development of cutaneous nodules and subcutaneous tumors arising from the peripheral nerves. Since von Recklinghausen's publication in 1882 numerous additional cases have been reported in the literature which have altered the conception of this disease. It is now generally considered to be hereditary in character (Preiser and Davenport;[21] Gardner and Frazier;[8] Sharpe and Young[23]). Among the case reports which have brought to light new aspects of this disease are included: pigmentation of the skin (Thomson;[27] Leader and Grand[13]), mental deficiency (Gordon;[9] Yakovlev and Guthrie[30]), involvement of the central nervous system (Cushing;[4] Aegerter and Smith[2]), congenital developmental defects (Thomson;[27] Ducroquet;[6] Ducroquet and Cottard[7]), and alterations in the skeleton (Adrian[1]; Gould[10]; Lehman and Brooks;[15] Barber[3]).

It is the purpose of this paper to present several additional cases of neurofibromatosis, one of which presents an unusual manifestation of this disease in the bones.

The diagnosis of neurofibromatosis is usually not difficult. Stout, Laidlaw and Haagensen[26] described the characteristic feature of Recklinghausen's disease as a proliferation of the tissues composing the peripheral nerves, including both the axis cylinders and their sheaths. The overgrowth may take place along the course of the nerve, produce a general thickening of the nerves or may involve their peripheral terminations. Bone changes, which are found in 7 per cent of cases (Hodges, Phemister and Brunschwig[11]), combined with the characteristic pedunculated soft tissue tumors and coffee colored splotches on the skin make the condition unmistakable.

SKELETAL CHANGES

Early reports of bone changes in neurofibromatosis are found in the extensive literature of this condition (Adrian[1]). Basing his opinion primarily on the alterations in the bones, Stahnke[24] was the first to suggest that the affection is a deep seated systemic disease. Weiss[29] had previously called attention to the common occurrence of scoliosis with neurofibromatosis.

In 1924 Lehman and Brooks[15] classified the bone changes in Recklinghausen's disease as (1) scoliosis, (2) abnormalities of growth of the individual bones associated with elephantiasis, and (3) irregularity in the outline of the bones ranging from central and subperiosteal cysts to pedunculated subperiosteal tumors. The authors describe as the fundamental cause of the bone changes the development of a neurofibroma in one of the periosteal nerves. As the tumor enlarges, pressure is exerted on the bone cortex causing erosion and pit formation. These depressions are filled with neurofibromatous tissue. In the roentgenogram they sometimes take on the appearance of cysts and at times a thin shell of cortex covers the fibrous tissue. Five of the 7 cases reported showed roentgen evidence of bone involvement. Biopsies were obtained in 2 of the cases but in neither instance could any actual infiltration of the bone substance by neurofibromatous tissue be demonstrated.

Gould[10] examined microscopically portions of the skeletons of 5 cases of neurofibromatosis. One of these cases, which presented typical changes of osteomalacia, showed also characteristic microscopic findings. A second case showed similar changes although somewhat less marked. There was

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no evidence of invasion of the bone by neurofibromatous tissue. The remaining 3 cases showed no abnormalities in the bones. Increased porosity and softening of the bones were described by Lehman and Brooks[15] which they attributed to the hyperplastic changes in the lymphatics associated with the growth of the neurofibroma. Subsequently Lehman[14] reported a case in which a biopsy removed from an enlarged innominate bone showed a marked osteoporosis with large haversian spaces and a thin cortex. He was unable, however, to demonstrate neurofibromatous tissue within the bone. The bone cut with great ease at the operation. The hypothesis was advanced that with the increased porosity and softening of the bone there is a growth in the length of the bone which is distributed throughout its entire extent instead of being confined to the region of the epiphyseal cartilage. Conversely, the presence of neurofibromatous tissue growing in such a way as to destroy the epiphyseal cartilages results in an abnormally short bone. Nørgaard,[19] however, is of the opinion that differences in the length of bones can be accounted for on the basis of an embryonal defect. Moore[18] finds strong evidence that overgrowth is the result of a segmental relationship between the affected nerve and the bone. Spontaneous fractures of bones and the development of a pseudarthrosis have been described in bone which showed osteoporosis.

Scoliosis is found frequently in neurofibromatosis. Miller[17] reported it as a finding in 43 per cent of cases. He describes the deformity as fairly characteristic, consisting of a kyphoscoliosis which differs in several important details from the usual type of kyphosis or scoliosis. The usual site is the lower portion of the thoracic spine. The kyphotic element was found to be strongly predominant while the scoliosis is slight and presents a moderate degree of rotation. The cause of the scoliosis has been attributed to bone softening (Gould[10]), to neurofibromata of spinal nerves (Lehman and Brooks[15]), to asymmetry of the extremities (Nørgaard[19]), and to developmental defects in the vertebrae (Moore[18]).

The following case illustrates a striking deformity of the thoracic spine which apparently has its origin in a congenital defect.

CASE 1 (Unit No. 388828). E. K., a white baby, was first admitted to the hospital March 3, 1910, at the age of four and a half months when his mother noticed an angulation of the ribs on the right side near the attachment of the spine. She attributed this to an injury sustained when the child was dropped by his nurse. At the age of six and a half months cord-like masses were observed in the intercostal spaces between the seventh, eighth, ninth and tenth ribs on the right side. A diagnosis of neurofibromatosis was made at this time. At the age of four years he had a series of nose bleeds. By the time the patient reached his fifth birthday his spine began to show an angular deformity which increased gradually, reaching its maximum at about seventeen years. A pedunculated lump developed below the spinal deformity which increased in size until it reached the dimensions of a football. On several occasions this lump was injured accidentally, causing hemorrhage within it, which was complicated by a secondary infection. This required hospitalization for incision and drainage.

The patient's father had numerous pedunculated tumors of the skin of the arms, legs and trunk, which on examination were found to be neurofibromata. Roentgenograms of his bones showed nothing unusual. A brother had several irregular brownish areas of pigmentation on the skin on the back of his neck.

Physical examination showed a marked dorsal kyphosis of the spine which forms a pointed lump with the vertex at about the tenth thoracic vertebra. The vertebrae are rotated toward the right so that the spinous processes point to the left a little anterior to the lateral plane. From the spine the ribs extend in a distorted manner forward to form a thoracic cage which is longer in an anteroposterior direction than laterally. The sternum is likewise very prominent. None of the other bones seem to be affected and measurements of the limbs show them to be symmetrical.

Arising from the kyphosis and the angle between it and the ribs on either side hangs a large pedunculated tumor mass composed of loose tissue which is covered by small papil-

lomatous masses. On the right side this extends around the side until it almost reaches the midline of the abdomen. Another isolated tumor of similar type is found on the left thigh. Several other smaller lumps are found on various parts of the body. Over the main tumor the skin is a light brown color, and in other parts of the body are also seen discolored areas without tumor formation.

Roentgenograms show a kyphosis of the lower thoracic spine which is so marked as to form a "hair pin" turn (Fig. 1). The vertebrae at the apex of the deformity are fused into an irregular bony mass in which only traces of the outlines of the separate vertebral bodies can be seen. Examination of the remainder of the skeleton discloses no other abnormalities.

Biopsies were taken from the lump on the left thigh and the large mass in relation to the spinal deformity. Both showed the characteristic appearance of neurofibromatosis.

Case II (Unit No. 352631). S. G., a white male, aged thirty-two, first noticed the appearance of pedunculated tumors in the skin at about eight years of age. These have greatly increased in size and number since that time. The patient's father has a similar skin condition. At about the time of the appearance of the skin lesions he bumped his right leg, which then gradually increased in size (Fig. 2). Ever since he can remember vision in the left eye has been poor. On physical examination a pulsating exophthalmos was found on the left with complete paralysis of the right rectus and impairment of the superior oblique and inferior oblique muscles. Considerable ptosis of the upper lid is also present.

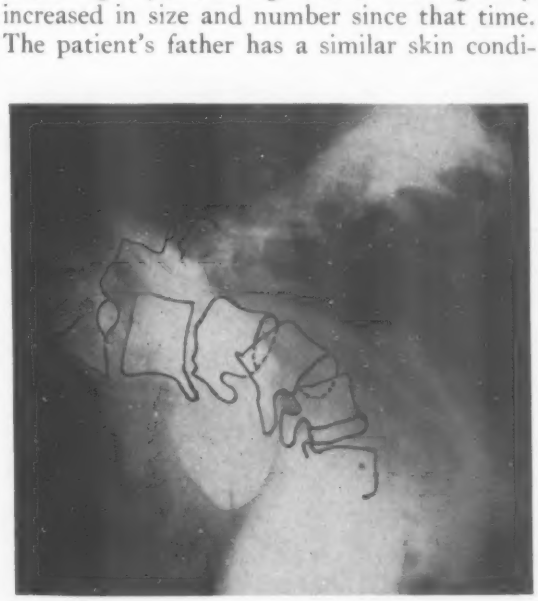

Fig. 1. Case I. *Neurofibromatosis with Congenital Deformity of Spine.* The deformity of the spine was noted at four and a half months of age. This has grown gradually worse, the maximum deformity being reached at seventeen years of age. A "hair-pin" kyphosis is present. The vertebral bodies at the apex of the deformity are fused into a solid bony mass, suggesting a congenital malformation.

Fig. 2. Case II. *Elephantiasis of Leg in Recklinghausen's Disease.* Patient first noticed pedunculated tumors in the skin at eight years of age. His right leg began to increase in size about the same time that the tumors in the skin appeared.

Roentgenograms of the skull disclosed a large defect in the lateral wall and roof of the left orbit with involvement of the anterior portion of the sphenoid bone on this side. Examination of the spine showed a rather marked scoliosis towards the right. A smoothly contoured concavity can be seen on the anterior aspect of the body of the fifth lumbar segment suggesting that erosion of the bone by a soft tissue tumor has taken place. Roentgenograms of the legs showed that the left leg is 3 cm. shorter than the right. The tibial shaft is widened in both diameters by the formation of irregular cortical

FIG. 3. Case II. *Neurofibromatosis of Tibial Shaft.* The tibial shaft is widened in both diameters by the formation of irregular, central and subperiosteal new bone. In the middle third of the shaft several smoothly contoured concavities can be seen at the margin of the bone caused by periosteal fibromas.

and subperiosteal new bone. In the middle third of the shaft several smoothly contoured concavities can be seen at the margin of the bone caused by periosteal neurofibromas (Fig. 3).

Biopsy of one of the skin nodules revealed the characteristic changes of neurofibromatosis.

The skeletal changes in this case agree in practically every detail with the bone changes of Recklinghausen's disease as described by Lehman and Brooks.[15] The large defect in the wall of the left orbit is in all probability due to bone erosion by a neurofibroma.

CASE III (Unit No. 556522). D. B., a white girl, aged twelve, had complained of a "swelling" of two or three years' duration at the site of an unerupted first molar in the lower right mandible. This has increased slowly in size until on admission it presents itself as a smooth tumor extending from the lower right third molar area anteriorly to the first bicuspid region. Roentgenograms (Fig. 4) show that the lower right first permanent molar is retained within the body of the mandible. Surrounding the tooth is a wide area of rarefaction which extends to the gingival margin. The margins of the rarefied area are well defined and show an increase in bone density suggesting that the defect in the bone was caused by a cyst. The alveolar margin of the mandible appeared to be destroyed. Another smaller area of diminished density surrounding a retained deciduous root or another tooth bud can be seen a little anteriorly.

Exploration of the rarefied area in the mandible revealed that it was filled with a white, firm soft tissue which seemed to merge and blend into the surrounding tissues. However, microscopically the margin of the mass was found to be well demarcated and composed of neurofibromatous tissue. With Cajal's silver stain scattered nerve processes could be seen in the sections.

No other neurofibromata were found. The tumor probably arose on one of the nerves of the periodontal membrane which is richly supplied with nervous tissue and which corresponds to the periosteum in the long bones. No evidence was obtained that would indicate that the neurofibromatous tissue was infiltrating the

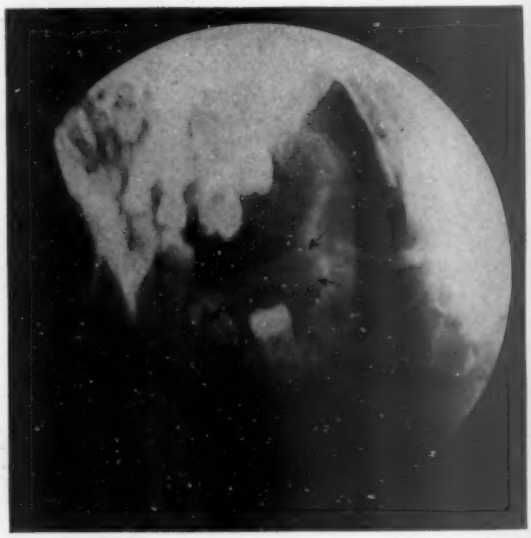

FIG. 4. Case III. *Neurofibromatosis of Mandible.* The patient complained of a swelling of two to three years' duration in the region of an unerupted first molar in the right lower mandible. The tooth is surrounded by an area of rarefaction with well defined margins which are increased in density. The alveolar margin has been destroyed.

bone. This case represents a localized form of neurofibromatosis.

Case iv (Unit No. 288186). A. M., a white male, aged thirty-one, farm hand, first came under observation February 13, 1931. The chief complaint was progressive weakness of the legs of eight years' duration and diarrhea following meals of four years' duration. The weakness of the legs began first with marked tenderness of the feet and attacks of cramp-like pains in the legs at night. Later a spastic weakness of the legs developed which became so severe that he was able to walk only with great difficulty. The diarrhea, which began four years prior to his hospital admission, was explosive in character, coming on soon after meals. The stools were watery and frothy and accompanied by the passage of considerable gas. There was no nausea or vomiting. Relief was obtained by the use of opium and belladonna.

For as long as he could remember, the patient had a large patch of "warty" skin on the upper half of the body on the left side. It extended from the level of the left ear down over the shoulder anteriorly and posteriorly including the axillary region. The skin of the medial aspect of the face, arm and fingers was also involved. Several years ago the skin behind the left ear began to thicken and a mass appeared which has grown progressively larger. It now presents itself as a soft, deeply fissured, egg-shaped tumor which exudes an offensive watery discharge.

Physical examination disclosed an undernourished and poorly developed young man.

Fig. 5. Case iv. *Neurofibromatosis of Pelvis.* There is a unilateral involvement of the left half of the pelvis and bones of the lower extremity by an osteosclerotic process. The left innominate bone is smaller than the right. Several radiolucent areas can be seen in the region of the acetabulum suggestive of cyst formation. The upper extremity of the left femur showed linear striations of increased density.

Fig. 6. Case iv. *Neurofibromatosis of Femur.* The lower end of the femur is widened in both diameters. The cortex of the shaft is thickened, most marked on its medial aspect. Several irregular cyst-like areas can be seen at the lower end of the shaft.

His head was unusually small. A definite asymmetry of the face, body and limbs was seen, the left side being smaller than the right. Because of the relative shortness of the left leg, the patient leans toward this side when standing. The left pupil was large, irregular and reacted sluggishly to light. The tongue was large, red, beefy and smooth on its edges. Both lower extremities were spastic and there was a bilateral Babinski. The deep reflexes of the legs were overactive. There was a transient ankle and patellar clonus. Vibratory sensation of the lower extremities was diminished to the iliac crests.

Laboratory studies, which included routine

Fig. 7. Case iv. *Neurofibromatosis of Tibia.* The cortex of the tibia is thickened, most marked on its anterior aspect. The margin of the bone is finely serrated. Coarse linear striations can be seen at the upper end of the shaft.

blood counts, serum phosphatase, proteins, calcium, sugar tolerance determinations, stool guaiac and gastric expressions, showed no remarkable variation from the normal.

Roentgenograms showed a unilateral involvement of the left half of the pelvis and bones of the lower extremity by an osteosclerotic process. The left innominate bone was distinctly smaller than the right. A number of relatively radiolucent areas were seen in the region of the acetabulum suggestive of cyst formation. The upper extremity of the femur showed broad linear striations of increased density (Fig. 5). The lower end of the femur was widened in both diameters, giving it a club-shaped appearance (Fig. 6). There was also bowing of the lower half of the shaft with the convexity directed anteriorly and slightly outwards. The cortex of the bone was thickened most markedly on its medial aspect while anteriorly the cortex was found to be thinner than usual. Several irregular, cyst-like areas were seen in the bone at the lower end of the shaft. The tibia also showed a thickening of its cortex similar to that seen in the femur (Fig. 7). This is most marked on its anterior aspect. Here the margin of the bone was finely serrated. Coarse linear striations can be seen at the upper end of the tibial shaft but there was no evidence of cyst formation such as seen in the femur and in the region of the acetabulum. In the bones of the left foot, the cancellous portion of the tarsals and the first metatarsal show irregular striations of increased density and some widening of the shaft of the first metatarsal.

Biopsies were obtained from the pectoral muscle and several small nodules were removed from both arms. These showed the characteristic changes of neurofibromatosis. Because of the unusual sclerotic changes manifested in the bone, a biopsy was also obtained from the lower end of the femur. The cortex of the bone was found to be covered with smooth periosteal tissue and showed no irregularities. A piece of bone measuring approximately 2 by $\frac{3}{8}$ inch in diameter was removed, exposing the marrow cavity. The cortex of the bone was found to be denser than normal and in the process of cutting the bone with an osteotome, several chips came away in layers suggesting an abnormal brittleness. Some of the trabeculae of the medullary cavity also seemed to be denser than usually encountered.

Microscopic examination of the cortical bone showed no recognizable changes. Tissue from the marrow, however, showed a growth in the marrow spaces which very closely simulates neurofibromatous structure (Fig. 8). Accom-

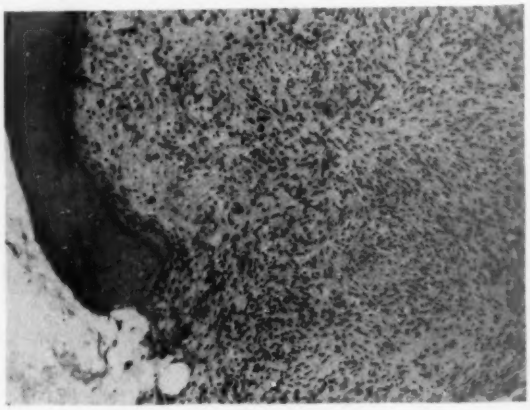

Fig. 8. Case iv. *Neurofibromatous Tissue in Bone Marrow.* Microsection from the marrow obtained from the lower end of the femur. The marrow spaces are filled with a neurofibromatous type of tissue.

panying this there are a great many lipoid containing foam cells and occasional small multinucleated giant cells. The presence of neurofibromatous type of tissue suggests that the bone changes were probably occasioned by direct involvement of the marrow space by the same process which has affected the peripheral nerves.

COMMENT

The presence of nerve tissue in both compact and cancellous bone has been amply demonstrated in man. Kölliker[12] in 1854 described in considerable detail the nerve supply of the bones. He listed Lushka, Kobelt, Engel and Beck among the earlier histologists who also had shown a nerve supply to the bones. Both sympathetic and cerebrospinal nerves have been found in the periosteum and it is from here that the chief nerve supply to the bones is derived. Minute trunks have also been described accompanying the nutrient vessels. The double source of nerve supply has been confirmed more recently by Stöhr.[25] He found a rich supply of nerves in the periosteum. From the periosteal nerves minute fibers enter the underlying bone through Volkmann's canals. Although nerve endings have been described by Maximow and Bloom[16] in extra-osseous connective tissue, they have never been identified in similar tissue within bone marrow. In connective tissue the nerve fiber first loses its myelin and then breaks up into fine terminal threads accompanied only by Schwann's nuclei. It does not seem unreasonable to assume, therefore, that the nerves in the bones terminate in the same way. Small nerves can usually be identified accompanying the larger blood vessels. Rarely an independent nerve trunk, largely autonomic in origin, has been observed. Nerve endings in the medullary tissues from this source have not been definitely identified.

In support of the presence of nervous elements in the marrow is the report by Peers[20] of a perineural fibroblastoma in this structure. De Santo and Burgess[5] also reported the occurrence of neurilemmoma in bone.

The relationship of the growth of neurofibromatous tissue in the marrow cavity and the sclerotic changes in the bone is not clear. Hyperostosis of the ilium was noted in one of the cases reported by Lehman and Brooks.[15] Weber[28] reported the case of a woman, aged forty-seven, with Recklinghausen's disease in which the shaft of the left tibia was greatly thickened and curved. Surrounding and completely covering the tibial shaft was a diffuse mass of thickened neurofibromatous periosteum. There was no evidence that the neurofibromatous growth had actually penetrated into the cortex of the bone. He attributed the hyperplasia of the underlying bone to the increased vascularity associated with the thickened neurofibromatous periosteum. Miller[17] observed areas of cranial hyperostosis that were in relation to overlying neurofibromatous soft tissue but no actual invasion of bone by neurofibromatous tissue had taken place. In the absence of neuromas overlying the sclerotic bone which might have produced these changes by chronic irritation, it might be supposed that this effect was caused by the neurofibromatous tissue in the marrow cavity itself. The presence of thickened medullary trabeculae in the tissue examined supports this view.

SUMMARY

The relationship of neurofibromata to peripheral nerves has long been recognized and the osseous changes associated with the development of neurofibromata from the nerves of the periosteum have been described.

Four cases of neurofibromatosis with bone involvement are herewith presented. In one instance neurofibromatous tissue was demonstrated in the marrow cavity of the femur. This suggests that nervous tissue must be present in bone marrow.

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GAS IN THE FETAL CIRCULATORY SYSTEM AS A SIGN OF INTRAUTERINE FETAL DEATH

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THIS case is reported to record a sign of intrauterine fetal death which was demonstrated within sixty-six hours after the absence of fetal movements was noted. To the best of our knowledge this has not been reported previously.

CASE 1. Patient, aged twenty-two, para II, gravida III, a controlled diabetic, approximately at full term, noticed the absence of fetal movements on the afternoon of April 9, 1943, and was examined roentgenographically April 12 in the morning. Both previous pregnancies had been allowed to go to full term and normal babies of 8 and 9 pounds had been born. The patient had no untoward clinical symptoms.

Roentgen Examination. On April 12, 1943, sixty-six hours after the absence of fetal movements had been noted a roentgenogram in the anteroposterior projection (Fig. 1) was taken with the patient erect to show the fetal skull. The cranial bones show no overlapping and

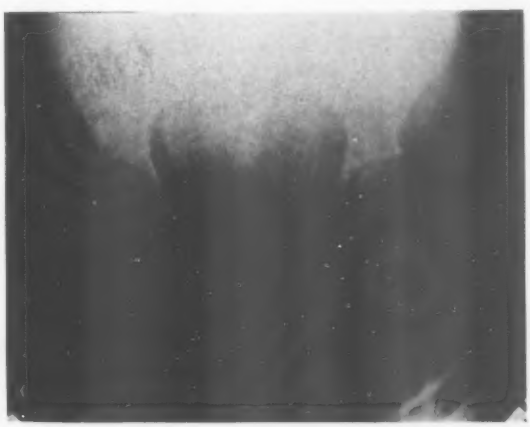

FIG. 1. Patient erect. Skull symmetrical.

give a symmetrical shadow. A roentgenogram in the right lateral projection with the patient horizontal (Fig. 2) and using a wedge-shaped filter as described by Vaughan[6] shows the shadow of a large, full term fetus with a protuberant abdomen and a well extended vertebral column.

The following areas of decreased density are noted: (1) A spiral of fairly constant diameter can be traced from the region of the fetal abdominal shadow to the peripheral zone of the uterine shadow. (2) Two parallel narrow lines

FIG. 2. Lateral projection, patient horizontal. Wedge shaped filter of Vaughan[6] used.

traverse the shadow of the lower portion of the fetal abdomen, extending from the region of the umbilicus to the region of the pelvis. (3) A tree-like radiolucent area is present over the region of the fetal liver. (4) Over the fetal thoracic shadow a bilocular area is shown, which, due to its size, shape and position, suggests the demonstration of the cardiac chambers. (5) A large oval area is present over the shadows of the upper four fetal lumbar vertebral bodies.

The placenta is implanted on the anterior wall of the upper uterine segment.

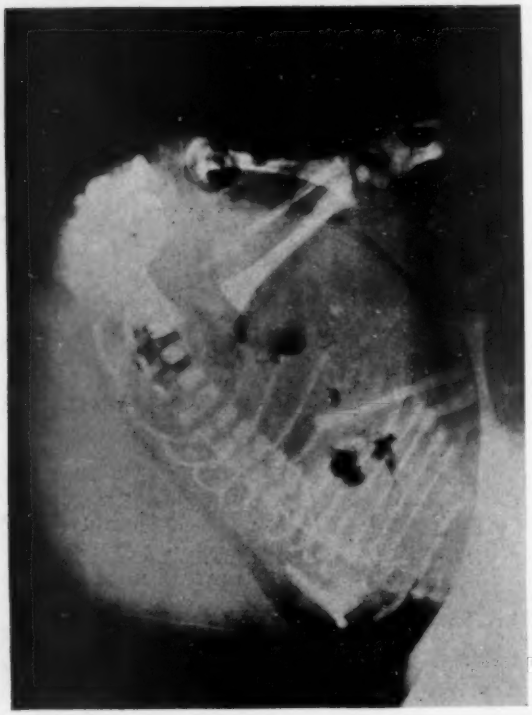

FIG. 3. Lateral projection, forty-eight hours after Figure 2. Slight increase in size of areas of decreased density.

FIG. 4. Patient erect. Fluid levels showing

Conclusion: The areas of decreased density noted above are interpreted as evidence of gas in the fetal circulatory system. As such, they indicate that the fetus is dead.

April 14, 1943. The roentgenogram (Fig. 3) of the abdomen with a right lateral projection shows the radiolucent areas demonstrated on April 12, and these are increased very slightly in extent. The fetal extremities are in practically the same position as at the earlier examination and their shadows in these serial roentgenograms can be almost exactly superimposed.

FIG. 5. Anteroposterior roentgenogram of stillborn baby immediately after birth.

A further roentgen study (Fig. 4) was made with the patient in the upright position and this shows fluid levels in at least two of the areas of decreased density, no abnormal flexion of the fetal skeleton and no overlapping of the fetal skull bones.

Conclusion: The earlier diagnosis of intrauterine fetal death is corroborated.

Delivery. Medical induction of labor was instituted and an uncomplicated delivery terminated April 15 at 11:00 A.M. The liquor amnii was not discolored and there was no abnormal odor.

Roentgen Examination of the Fetus and Placenta (Fig. 5 and 6). This examination was performed immediately and showed more clearly the areas of decreased densities noted above. These radiolucent areas appeared to demonstrate portions of the fetal circulatory system and the following structures were identified: both umbilical arteries and portions of the umbilical vein; the common iliac arteries; external iliac arteries; the femoral arteries; the abdominal aorta; blood vessels of the liver and mesentery; the chambers of the heart; pulmonary vessels; carotid, facial and intracranial vessels. The exact location of the radiolucent area in the left side of the abdomen was not determined.

Autopsy Report. Within an hour of delivery an autopsy was performed by Dr. G. A. McCurdy, Pathologist of the Royal Jubilee Hospital, Victoria, B.C., and his report is herewith summarized.

The body was that of a full term male baby with a marked degree of maceration of the skin and desquamation. The cranial bones were partially separated and the brain was completely liquefied. The heart was opened under water and gas escaped from both right and left ventricles. The liver was opened under water and gas escaped from the cut surfaces. The tissues around the left kidney were infiltrated with gas. The umbilical cord was opened under water and gas escaped. All organs showed a marked degree of autolysis.

Fig. 6. Lateral roentgenogram taken at same time as Figure 5. Much of the circulatory system is clearly demonstrated.

Fig. 7. Case 11. Roentgenogram made immediately after birth of stillborn baby. Gas is present but not as clearly shown as in Case 1.

Anatomical Diagnosis. (1) Marked maceration and autolysis of a stillborn baby; (2) presence of gas in heart, liver, retroperitoneal tissue and umbilical cord.

ACCEPTED SIGNS SUGGESTIVE OF INTRAUTERINE FETAL DEATH

1. Overriding of the skull bones with cephalic asymmetry recorded by Horner[2] and by Spalding.[3] Such a change has been demonstrated in a living fetus and reported by Chalmers.[1] The above case showed a symmetrical cranial shadow.

2. Marked bending of the spinal column, given by Szellö[4] as the earliest sign. In the

above instance the vertebral column was unusually extended.

3. Lack of change in the position of the fetal bones of the extremities in serial roentgenograms suggested by Thoms.[5] This immobility was very well demonstrated in our case.

4. Failure of the size of the fetal bones to correspond to the duration of pregnancy.

5. Haziness of landmarks and contours, or entire absence of bony shadows in repeated examinations.

CASE II. During the preparation of the above report examination of another full term, slightly macerated fetus was possible and this study is included (Fig. 7). This roentgenogram, taken with a lateral projection immediately after birth, shows areas of decreased density similar to those demonstrated in Case I, and these are interpreted as evidence of gas in the fetal circulatory system.

SUMMARY

1. A roentgenological diagnosis of intrauterine fetal death was made by the demonstration of gas in the fetal circulatory system.

2. A second case showing gas in the circulatory system of a stillborn fetus is reported.

3. Study of this phenomenon and of the nature of the gas is being continued and further reports will follow. It is suggested that careful examination with the lateral projection of patients suspected of intrauterine fetal death may show that this sign is of primary importance.

I am deeply indebted to Dr. H. H. Murphy, Director of the Radiological Department of the Royal Jubilee Hospital, Victoria, B. C., for this helpful direction and valuable advice; to Dr. G. A. McCurdy, Director of the Pathological Department; to Dr. G. B. B. Buffam, whose case I reported and to Dr. M. W. Calvert, of our Interne Staff, for his skillful preparation of the illustrative material.

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DISLOCATION OF THE HIP ASSOCIATED WITH SPINA BIFIDA*

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IN HOSPITALS and sanitaria devoted to the care of chronic diseases, there is an opportunity to observe the progress and end-results of chronic diseases not as a rule seen either in office practice or in hospitals caring for acute diseases. We have had occasion for this reason to observe 3 cases of spina bifida in conjunction with dislocation of the hip which we followed for prolonged periods of time until their death occurred from intercurrent complications. The association of dislocation of the hip with spina bifida is a recognized entity, yet very few instances are reported in the literature and we believe that a report of 3 additional cases should be of interest. The above findings occurred in 3 girls born with visible tumor formation in the lumbosacral region of the spine. Each was operated on soon after birth for the spina bifida. Two died at the age of twelve from an ascending urinary infection and the third died at the age of twenty from an unknown cause; this case also showed signs of urinary tract involvement.

REPORT OF CASES

CASE 1. E. R., female, aged fifteen, was admitted to the institution on July 23, 1936. She was a fourth child of six, was a full term baby, and had been delivered spontaneously. At birth a protruding mass was noted in the sacral area, and when the patient was five weeks old she was operated on. She remained at home until she was six years old and later on spent her life in various institutions. As a child her head seemed unduly large but diminished in size in later years. She was able to sit up at three years of age but never developed control of her sphincters. At an early age she underwent several orthopedic operative procedures to improve her gait, with some beneficial effect.

Physical examination at the time of admission disclosed an obese girl with fair mentality. She was of short stout stature and showed precocious physical development. She was able to walk on crutches. The muscle power survey revealed ability to flex the right hip in the recumbent position up to 60°, flexion of the knee to about 90°, with no dorsiflexion of the ankle. There was no motor power of the abductor muscles. On the left there was very little motor power of the leg. Passive flexion of the knee was possible to 45°. Genu valgum of the left side was noticed amounting to 25°, 15° of which represented a fixed deformity and 10° was due to laxity of the internal ligaments of the knee joint. In addition genu recurvatum was present. Marked lordosis with prominence of the sacral area was evident. Left foot was in varus position. Sensation was absent from the lower legs down. Over the sacrum and over both buttocks there were numerous small decubitus ulcers. The deep reflexes were diminished bilaterally, weaker on the left side, and the Achilles tendon reflex on the left side was absent.

FIG. 1. Case 1. Extensive defects of the posterior segments of the fifth lumbar vertebra and sacrum. Bilateral dislocation of the hips with false acetabular activities, and evidence of a shelf operation on the left side.

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FIG. 2. Case II. Defects of posterior segments of the third, fourth and fifth lumbar vertebrae and the entire sacrum. Dislocation of the left hip. Bilateral hydronephrosis.

Laboratory examination showed the presence of albumin and white blood cells in the urine on several occasions.

She died at the age of twenty with no apparent immediate cause of death discernible except for evidence of an ascending urinary infection. She was found dead in bed after being up in the ward with other patients the night before.

Roentgen studies revealed almost complete absence of the posterior segments of the fifth lumbar and first, second and third sacral segments. There was a bilateral dislocation of the hips and formation of false acetabular cavities on both sides. The head and neck of the femur on the right appeared normal. On the left the head and neck showed considerable distortion and there was also evidence of a previous surgical procedure with the formation of a shelf on the left side (Fig. 1).

CASE II. G. G., female, was admitted to the hospital on December 10, 1936, at the age of seven. She was the first child of her parents and was delivered in breech presentation after three days of labor. A visible tumefaction of the lumbosacral area was removed by operation when she was one week old. She was never able to control the sphincters. Until three months old she did not move her legs at all; however, later she gradually developed the ability for gross movements of the legs but was never able to move her toes and never learned how to walk. She stayed at home until three years of age and later was hospitalized in various institutions.

Physical examination on admission disclosed an alert child with a tendency towards obesity. She stood with a backward displacement of the pelvis and an exaggerated lumbar lordosis. Motor power survey revealed the gluteal muscles on both sides to be markedly atrophied. The power of the right quadriceps was fair. The abductors, adductors and rotators were fair. The hamstrings were weak. There was no motor power in the leg and foot muscles. On the left side the thigh muscles were fair except the abductors and external rotators. Both knees showed a genu recurvatum deformity. The deep reflexes were absent bilaterally; analgesia below the fourth lumbar vertebra was found, the position sense was lost, and the vibratory sense was absent in the toes but somewhat perceptible in the tibia and ankle. Bilateral foot drop was present.

Three years after admission the patient began to have spisodes of spiking temperatures. Urinalysis showed the presence of albumin, red blood cells, and white blood cells. The patient would improve after therapy for a short period and the symptoms would recur soon afterwards.

FIG. 3. Case II. The spinal defect is clearly shown. The left hip is now in relatively normal position and easily replaced.

The clinical course was later characterized by marked anemia and urea nitrogen retention. She died as a result of a pyelonephritis at the age of twelve.

Roentgen examination showed the presence of an extensive defect involving the posterior segments of the third, fourth and fifth lumbar vertebrae and the entire sacrum. The left hip was dislocated. The left femoral head appeared relatively well developed. There was a slight flattening of the capital epiphysis. The left hip could be easily replaced but would just as readily dislocate itself. The pyelogram showed marked bilateral hydronephrosis.

This case illustrates the rôle of the muscle imbalance in the production of the dislocation. (See Figures 2 and 3, before and after dislocation.)

Case III. R. P., female, was admitted to the hospital at the age of twelve. She was an only child. The family history was essentially negative. When she was two days old a spina bifida of the lumbosacral area was surgically removed. She never developed control over the sphincters and never was able to walk without assistance. At the age of two she developed pyelitis. The infection was severe and only after repeated transfusions did she recover. Frequent ureteral catherization was necessary subsequently to relieve exacerbations of urinary symptoms.

Physical examination on admission revealed a rather thin girl of excellent mentality. She complained of constant pain in both lumbar areas. Muscle survey showed fair power in both quadriceps muscles and internal rotators. The abductors and external rotators were paretic. There was no motor power in the leg and ankle muscles. There was bilateral drop foot. The knee and ankle reflexes were not elicited, and there was complete loss of sensation below the fifth lumbar vertebra.

Laboratory examination disclosed the presence of albumin, white blood cells, and red blood cells in the urine. Examination of the blood revealed the presence of a marked anemia.

This patient died soon after admission of uremia at the age of twelve.

The roentgenograms showed the presence of a defect involving the posterior segments of the fourth and fifth lumbar and the entire sacral spine, also marked distortion of the lower end of the sacrum and coccyx. Bilateral dislocation of the hips was present with upward riding of both femora (Fig. 4). The development of both femora including the head and neck on both sides aside from generalized atrophy was essentially negative. The acetabula, however, were not well developed. An intravenous pyelogram showed a bilateral hydronephrosis.

Fig. 4. Case III. Irregular defect involving the posterior segments of the fourth and fifth lumbar vertebrae and the entire sacral region. There is a bilateral dislocation of the hips with upward riding of both femora. There is evidence of a bilateral hydronephrosis shown by an intravenous pyelogram.

DISCUSSION

Spina bifida is a congenital developmental defect of the neural canal characterized by imperfect closure of the spinal lamina. Associated with this defect are abnormalities of the overlying skin and subcutaneous tissues and of the underlying meninges and spinal cord. It is most common in the lumbar and sacral regions but may be encountered in the cervical and thoracic regions. In its severe forms it is accompanied by other anomalies, the most important of which are: anencephaly, hydrocephalus, talipes equinus, harelip, cleft palate, and so forth. Myelocele, meningomyelocele, meningocele, and spina bifida occulta are only differences in degree of severity of involvement.

Clinical Features. When the protruding sac is exposed and susceptible to infection, these patients seldom survive for very long without surgical correction. In the milder cases, owing to the survival of the patients, time is allowed for the development of the more remote effects of the neural involvement. As the abnormality most commonly occurs in the lumbosacral region, the neurological signs manifest themselves in the lower limbs. Frequently one group of muscles show fair power whereas antagonistic muscles may show complete paralysis due to the neural defect. This combination of paralysis in one group of muscles and fair motor power in another group was present in our cases. Sphincter disturbances are common, the most important being incontinence of urine. Fecal incontinence occurs but is less frequent.

In the pathogenesis of dislocation of the hip two types are distinguished: the endogenous type, the result of developmental arrest in the acetabular roof in contrast to the dynamic type caused by the presence of abnormal forces which are responsible for the dislocation of the femoral head from the acetabulum. In the cases reported the dislocation suggests a paralytic origin brought about by two factors: the relaxation of the ligaments around the hip, and the muscle imbalance. The dislocation usually occurs in the absence of muscle power within the abductors and external rotators. In our 3 cases this muscle imbalance was demonstrated by the muscle survey. The maldevelopment of the acetabular cavities and the atrophy of the femora may be accounted for by the factor of disuse rather than by endogenous involvement of the acetabulum, which produces congenital dislocation.

SUMMARY

Three cases are presented showing the association of spina bifida and dislocation of the hips. From the physical and roentgen examination we believe that the dislocations are the result of the neural defect produced by the spina bifida and not the result of multiple anlage defects, although the latter cannot be ruled out. These cases are of interest because of the relative infrequency of this complication of spina bifida and the few cases reported in the literature.

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Vol. 51, No. 5

WERNER'S SYNDROME

By SAMUEL T. HERSTONE, M.D., *and* JACOB BOWER, M.D.
From the Department of Roentgenology of the Montefiore Hospital for Chronic Diseases
NEW YORK, NEW YORK

IN 1934 Oppenheimer and Kugel[5]* reported for the first time in this country on a heredofamilial disorder consisting of scleroderma, bilateral juvenile cataracts, precocious graying of the hair, and other endocrine stigmata which they called Werner's syndrome. In the European literature 10 similar cases have been reported. These include papers by Werner,[8] Bloch and Stauffer,[2] Rothmund,[7] Barbot,[1] Krebs, Hartmann and Thiébaut,[3] and Mamou.[4] There are only 3 cases in the American literature, all of them from Montefiore Hospital where they were studied for many years. All 3 patients are now dead and have been autopsied. They showed remarkable similarities in their clinical and roentgenologic appearances. It is the purpose of this paper to describe the roentgenographic findings in the hope that more cases of this unusual and interesting syndrome will be added to the 3 already described.

The etiology of the disease is obscure. However, there is no doubt that the disease is familial. This is definitely shown in the cases published by Werner and by Barbot. Two of the 3 patients to be discussed in this paper were brothers. Although the etiology is obscure, the disease is essentially a degenerative one, probably caused by some defect in the mesodermal and ectodermal tissues.

The clinical syndrome is characterized mainly by premature senescence associated with some features of juvenilism. There is generalized underdevelopment of all the endocrine glands resulting in hypogenitalism, gynecomastia and eunuchoidism. In the female there are menstrual disorders, including premature total amenorrhea occurring as early as sixteen years of age. Occasionally some evidence of thyroid insufficiency may be present.

Vascular changes are an outstanding feature of the disease. There is clinical evidence of extensive and widespread arteriosclerosis of the Mönckeberg type beginning in the third decade of life. The peripheral vessels are tortuous and non-compressible. The major clinical changes, however, appear in the ectodermal structures. Whether these are secondary to vascular impairment or to changes primarily in these structures is difficult to evaluate.

Skin. The predominant changes in the skin suggest a combination of scleroderma and poikiloderma. (The precise status of these changes is still a matter of dispute.) This is most marked in the distal portions of the extremities, especially in the lower extremities where it is often associated with recurrent ulceration and subsequent gangrene necessitating amputation.

Hair. All cases show premature graying of the hair, with onset as early as the eighth year. The graying is rapidly followed by alopecia.

Cataracts. Bilateral cortical cataracts are a constant finding. These generally begin in the third decade of life and progress rapidly, so that early in life these patients need surgical intervention to prevent blindness.

Voice. The voice is changing in character and has been described as rasping and high pitched.

Pathological examination of 3 patients has contributed very little to our understanding of the etiology or pathogenesis of this disease. All 3 patients showed a striking resemblance during life. They were often mistaken for one another. All died at approximately the same age—forty-one, forty-two and forty-four years. It is interesting that the cause of death was different in each; one died of myocardial failure, as

* The cases described by these authors are the ones used in this paper for the evaluation of the roentgenographic findings.

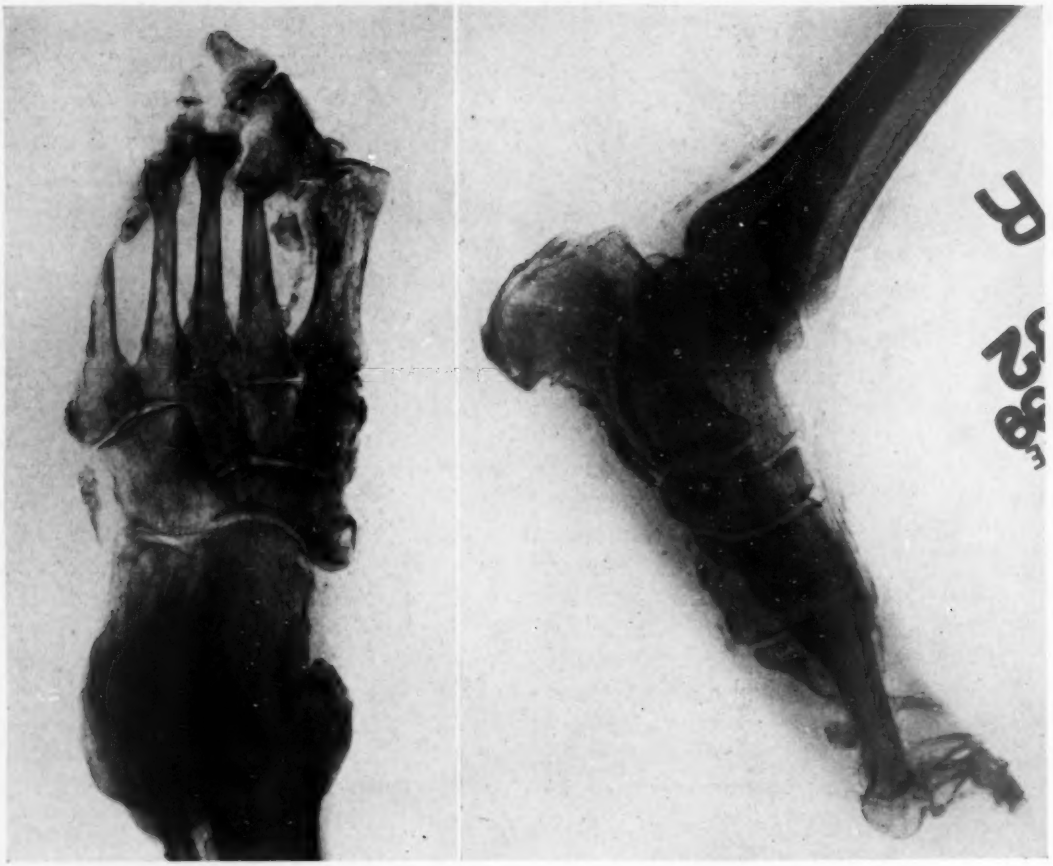

FIG. 1

a result of far advanced coronary disease; another died of a primary carcinoma of the liver with subsequent metastasis, and the third died of a fibrosarcoma of the forearm with extensive pulmonary metastasis.

One of the 3 cases showed evidence of increased parathyroid activity. This was evidenced microscopically by the increased numbers of large clear cells. During life, this patient showed some findings suggestive of hyperparathyroidism. These included a positive Hamilton test and calcium levels up to 13.0 mg. However, the other 2 cases had small parathyroid glands and no clinical evidence of hyperactivity. The blood phosphatase in all cases ranged from 4 to 8 Bodansky units.[9] The other endocrine glands were small and atrophic.

ROENTGENOGRAPHIC FINDINGS

The roentgenographic findings are characterized by extensive calcification in the arteries and soft tissues.

(1) *Arterial Calcification.* There is extensive calcification of the Mönckeberg type. This involves all arteries except those of the brain and lungs. The changes are most marked in the distal parts of the extremities (Fig. 1 and 2), especially the lower extremities, where one can identify all the arteries including the plantar and dorsal arches, as well as their digital branches. The same is true of the hands, but to a lesser degree. Extensive calcification is also seen in the abdominal vessels, particularly in the mesenterics (Fig. 3).

(2) *Calcification in the Soft Tissues.* Calcium was usually deposited in ligaments, tendons, bursae and subcutaneous tissues. At times it is difficult to determine in which of these structures the calcium is located, since they are so often intimately related.

All 3 cases showed calcification in or about the plantar calcaneocuboid ligaments, the metatarsophalangeal joints, both malleoli and the calcaneus at the point of attachment of the Achilles tendon (Fig. 1).

The knee joint also showed widespread involvement. There was calcification of the medial and lateral collateral ligaments, as well as the patellar ligament, and quadriceps femoris tendon (Fig. 4). Calcification was less marked about the hip joint where only 1 of the 3 cases showed some calcification. This was in the region of the trochanteric bursa. Calcification in the upper extremities was present in the region of the olecranon bursa, and the interphalangeal joints (Fig. 2 and 5). None of the 3 cases showed calcification of the subdeltoid or subacromial bursa. Two of the 3 cases showed small calcific deposits varying from pinhead to pea size scattered through the subcutaneous tissues over the tibia. These also were seen in the soft tissues about the small joints of the hand (Fig. 2).

(3) *Skull.* Examination of the skull revealed calcification of the pineal and an unusually small sella turcica in all cases (Fig. 6).

(4) *Larynx.* Roentgenoscopic examination of the larynx revealed rigidity of the epiglottis during the act of swallowing.*

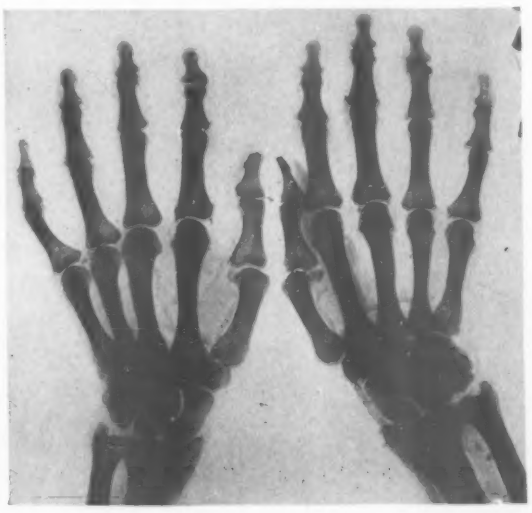

Fig. 2

Fig. 3

(5) *Osteoporosis.* Osteoporosis was confined mainly to the lower extremities. It was not extensive and could easily be explained on the basis of local disuse rather than any generalized disorder.

(6) *Periostitis.* One of the 3 cases showed periostitis over the tibia. This most likely was secondary to chronic ulceration and infection of the overlying skin and subcutaneous tissues.

DIFFERENTIAL DIAGNOSIS (ROENTGENOGRAPHIC)

(*a*) *Increased Parathyroid Activity* (primary or secondary). In increased parathyroid activity one not uncommonly sees metastatic calcification of blood vessels and soft tissues. However, in Werner's syndrome the calcification is entirely out of proportion to the osteoporosis. Osteoporosis is localized to the extremities. It is not severe and does not show cystic changes.

* Personal communication from Dr. Selma Shapiro.

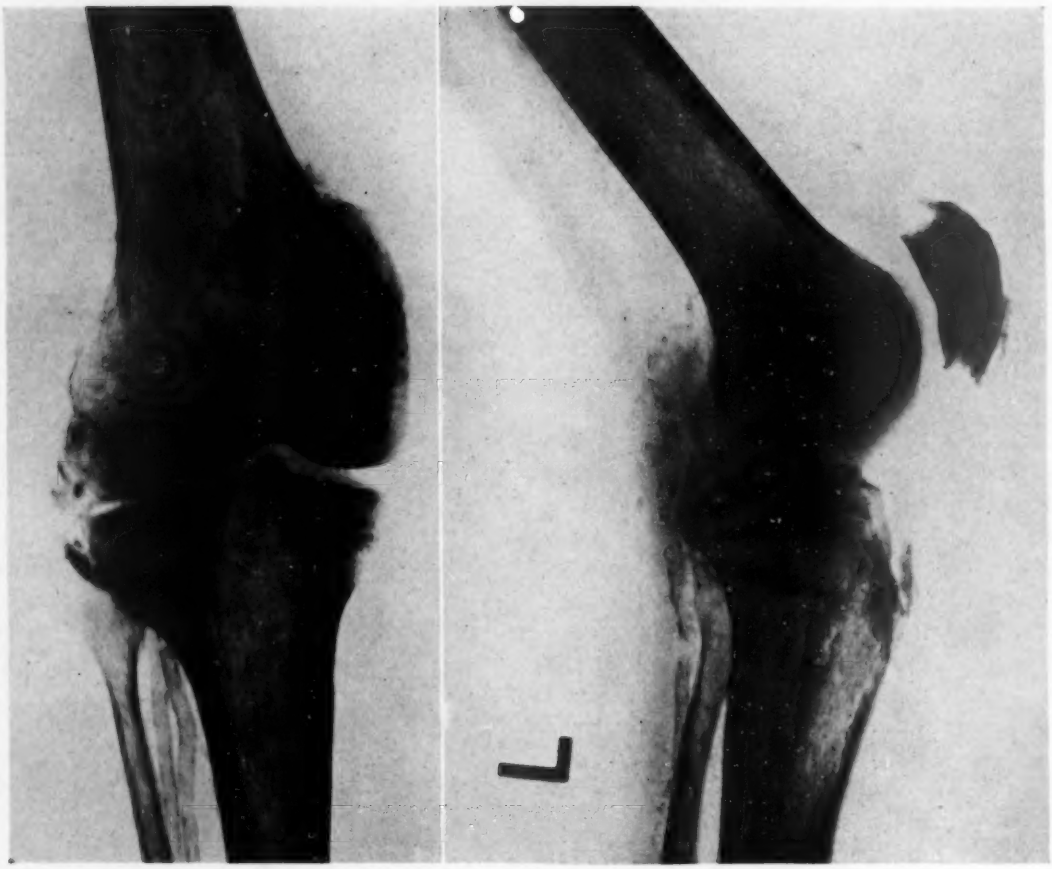

FIG. 4

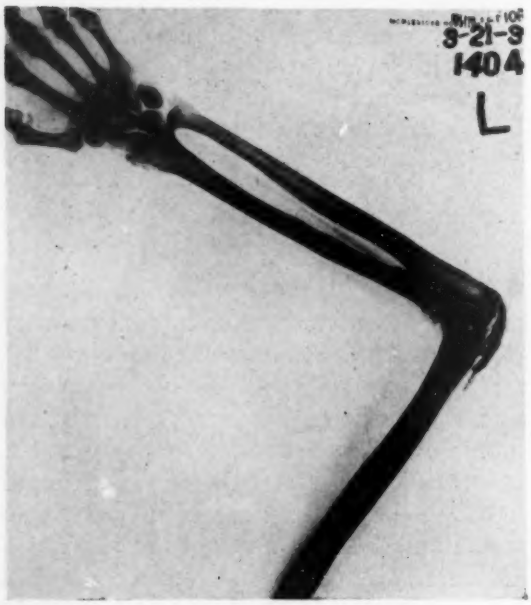

FIG. 5

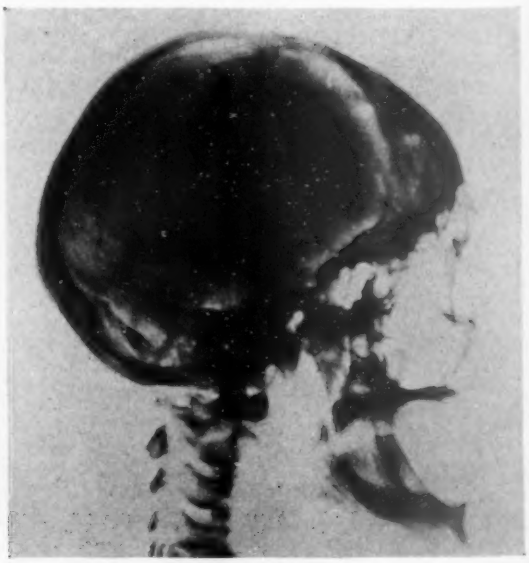

FIG. 6

(*b*) *Arteriosclerosis* (Mönckeberg). In advanced arteriosclerosis calcifications are not seen in the soft tissues. The relationship of the extent of arterial calcification to the age of the patient is of great importance in differentiating the two diseases.

(*c*) *Scleroderma.* In scleroderma calcifications are occasionally found in the subcutaneous tissues. However, there is no associated calcification of arteries, bursae, or ligaments. Scleroderma may result in absorption of the terminal tufts of the fingers and toes which is not seen in Werner's syndrome.

Where the differential roentgen diagnosis becomes difficult or impossible the clinical findings are generally sufficient to establish the diagnosis of Werner's syndrome.

SUMMARY

The roentgenographic findings in three cases of Werner's syndrome are presented. These include:

1. Metastatic calcification in the soft tissues, tendons, ligaments and bursae.

2. Extensive calcification of the media of all arteries except those of the brain and lungs.

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Twenty-eighth Annual Meeting: 1944, to be announced.

EDITORIALS

THE ROENTGENOLOGICAL APPEARANCE OF THE GASTROINTESTINAL TRACT IN SCLERODERMA

THE clinical and microscopic aspects of generalized scleroderma have been well studied. Most of the textbooks dealing with diseases in which scleroderma is discussed confine their discussion to the skin manifestations and the histopathology of the skin lesions, neglecting to mention the fact that esophageal dysfunction may occur early in the disease before it has assumed its characteristic picture. However, this feature of scleroderma was reported as early as 1903 by Ehrmann and several later reports have occurred in the literature, one of the most recent reports dealing with lesions of the esophagus in generalized progressive scleroderma being by Lindsay, Templeton and Rothman.[1]

From a study of their cases they too observed that esophageal disturbance is a characteristic manifestation of generalized scleroderma and that it is likely to appear early in the course of the disease. These esophageal disturbances are moreover in the early stages attributed to gastric dysfunction or they may be of such mild nature as to receive little or no attention. These early esophageal symptoms manifest themselves in inability to swallow more than a few mouthfuls of fluid rapidly, difficulty in swallowing while lying down and a sensation of fullness behind the sternum.

During their roentgenoscopic studies Lindsay, Templeton and Rothman observed that normal peristalsis is absent in the lower two-thirds of the esophagus and that the contents accumulate in this relaxed and dilated portion. The burning sensation in the chest in the region of the epigastrium, and neck, of which many of these patients complain, suggests the probability of regurgitation of gastric contents into the esophagus and resulting chronic esophagitis. The roentgenoscopic observations also brought forth evidence that this suggestion was well founded in fact in that the cardiac sphincter as well as the cardiac musculature above was affected by some degree of weakness.

It was also noted that chronic ulceration in the lower third of the esophagus localized chiefly to the region just above the phrenic ampulla. This chronic ulceration they attributed probably to a direct result of the esophagitis, with sclerodermatic changes as a predisposing factor.

In the later stages of the disease stricture formations of the esophagus occurred, limited to the region immediately above the phrenic ampulla.

While the esophageal disturbances associated with scleroderma have attracted the attention of many observers, the roentgenological appearance of the gastrointestinal tract in scleroderma, particularly the changes seen in the small and large intestine, have not been discussed until recently, except in the report of an isolated case by Rake.

Hale and Schatzki,[2] in the April issue of this JOURNAL, reported studies which they have made during the past five years at the Massachusetts General Hospital on twenty-two patients who were known to have scleroderma varying in duration from five months to twenty-two years. The roentgen examination in seven of this group of patients was carried out because of difficulty of swallowing of which the patients com-

[1] Lindsay, J. R., Templeton, F. E., and Rothman, S. Lesions of the esophagus in generalized progressive scleroderma. *J. Am. M. Ass.*, 1943, *123*, 745–750.

[2] Hale, C. H., and Schatzki, R. The roentgenological appearance of the gastrointestinal tract in scleroderma. AM. J. ROENTGENOL. & RAD. THERAPY, April, 1944, *51*, 407–420.

plained. However, the fifteen remaining cases had no symptoms referable to the esophagus and the examination in this group was carried out routinely for the purpose of determining whether or not there were changes in the stomach or intestinal tract somewhat comparable to or simulating those which had been observed in the esophagus.

Of the eighteen patients who had scleroderma who were examined roentgenologically only four showed changes in the small intestine. These changes that were noted were quite apparent and appeared to be of considerable clinical interest and importance as all of these four cases had symptoms referable to the gastrointestinal tract which indicated partial obstruction. The findings in the four cases that exhibited positive roentgen changes in the small bowel pattern were characterized by widening of the part of the small intestine involved, with marked delay in the emptying time of these loops. The dilatation involved the upper small intestine including the duodenum in all four patients and extended downward into the ileum in one, and in this case where the lesion was so extensive there appeared to be involvement of the colon as well.

These roentgen changes observed in the small intestinal loops must be differentiated from so-called deficiency diseases, in which the small bowel pattern has been so aptly described by Golden, and these changes must not be confused with paralytic ileus. The differentiation from paralytic ileus is fairly easy since the pathologic changes usually involve only a certain part of the intestine and the clinical symptoms of the patient are never so acute in scleroderma as those found in paralytic ileus. However, the similarity of the changes seen in severe cases of deficiency disease to those in scleroderma is somewhat striking, the difference, however, being that the abnormalities seen in the small intestine in scleroderma appear to be more localized. Clinically apparently none of the patients exhibiting scleroderma showed evidence of avitaminosis and those patients having scleroderma who were treated intensively with vitamins showed no improvement in the appearance of the small bowel pattern.

While Hale and Schatzki could not prove that the changes seen in scleroderma were not produced by some deficiency, it was their impression and belief that the changes in the small intestine have some similarity to those in the esophagus, and while it was not the purpose of their paper to discuss the origin of the changes observed in the gastrointestinal tract they thought that these might be explained on the basis of local intestinal changes or of some neurotrophic disturbance.

They also observed in two cases a questionable involvement of the colon in which the colon exhibited areas of increased rigidity between areas of sacculation.

This paper by Hale and Schatzki is of great importance because it calls attention to a hitherto unsuspected or not generally appreciated fact that the lesions of the gastrointestinal tract seen in patients suffering from scleroderma are not limited to the esophagus but are more widespread in the gastrointestinal tract, involving the small intestine and probably also the large bowel, and these gastrointestinal changes are of considerable clinical importance. The lesions of the esophagus simulate to some extent cardiospasm whereas those seen in the small intestine simulate ileus or deficiency disease and must be differentiated from them.

ALBERT FRANKLIN TYLER
1881—1944

ALBERT FRANKLIN TYLER, of Omaha, Nebraska, a member of the American Roentgen Ray Society since 1915, died on February 25, 1944, at the age of sixty-two. Truly a physician, memorialized by his own county society as having served his profession well indeed, Dr. Tyler died of coronary thrombosis. Several months earlier he had a series of coronary episodes, but he preferred to return to his work and take his chances rather than to have a possibly longer life of enforced inactivity. He died in Immanuel Hospital, where he was attending radiologist from 1915 on.

Dr. Tyler was born in Logan County, Illinois, on March 14, 1881. He was gradu-

ated from Nebraska Wesleyan University in 1904, and was later a trustee of this University, and from Creighton University Medical School in 1907. He was a member of the medical fraternity of Phi Rho Sigma, and of the honorary scholastic fraternity of Phi Kappa Phi. After serving an internship in the Omaha General Hospital, he took post-graduate studies at Johns Hopkins University Medical School and at the New York Post-Graduate Medical School.

He was clinical professor of radiology and physical therapy for many years at his Alma Mater. He was a founder of the American Congress of Physical Therapy; in 1932 he received its gold key award; in 1933 he was its president. He was a member of the American Radium Society and of the British Röntgen Society, a fellow of the American College of Physicians, and a past president of the Radiological Society of North America, in addition to the Omaha Douglas County Medical Society, the Nebraska State Medical Association, and the Nebraska State Radiological Society. He was a former associate editor of the *Nebraska State Medical Journal*, and editor and publisher of the *Journal of Radiology*, which later became the *Archives of Physical Therapy*. He contributed freely of his time, energy, and money to the History of Medicine in Nebraska, which he edited, and which was published in 1928.

Dr. Tyler is survived by his wife, who was Miss Charlotte Ellen Roe of Omaha, by a daughter, Mrs. Eugene Stromberg, of Ithaca, New York, and by a son, Edward Tyler, of Omaha.

JAMES F. KELLY

HENRY P. ENGELN
1870—1944

THE following Resolution of the Cleveland Radiological Society was ordered at the February, 1944 meeting:

WHEREAS: Death has removed from our Society, Mr. Henry P. Engeln, the following brief outline is submitted for incorporation in the records.

He was born in Paris, France, in 1870 and died at St. Luke's Hospital, Cleveland, Ohio on February 7, 1944. He came to the United States with his parents, when he was about fifteen years of age; they settled in Chicago, Illinois. There he grew to manhood and was in business with his brother, until he came to Cleveland, about the year 1900. Here he engaged in the manufacture of revolving plate static machines. This first brought him in touch with the x-ray field. He cooperated with Dr. George Iddings in establishing the first x-ray laboratory in Cleveland, which was located in the Caxton Building on Huron Road. He continued in this field the rest of his business life. He was associated with several leading x-ray organizations and for many years headed his own, the H. P. Engeln Co. He was always interested in everything pertaining to this branch of medicine. He regularly attended both national and international meetings; he was known to hundreds of radiologists and probably knew personally more pioneer radiologists than any other member. Even after retiring from active work a few years ago, he visited and enjoyed being with his old x-ray friends.

As a Society we wish to extend to his family our sympathy at his passing and assure them we hold fondly the memory of this friendly friend.

THEREFORE: Be it ordered that a copy of this Resolution be sent to the family, the AMERICAN JOURNAL OF ROENTGENOLOGY and *Radiology*.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Joint Meeting of American Roentgen Ray Society and Radiological Society of North America, Palmer House, Chicago, Ill., Sept. 24–29, 1944.

American College of Radiology
Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill. Annual Meeting: Stevens Hotel, 10:00 A.M., June 14, 1944.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: Chicago, Ill., June 12–16, 1944.

Arkansas Radiological Society
Secretary, Dr. J. S. Wilson, Mack Wilson Hospital, Monticello, Ark. Meets every three months and also at time and place of State Medical Association.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: Joint Meeting of American Roentgen Ray Society and Radiological Society of North America, Palmer House, Chicago, Ill., Sept. 24–29, 1944.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

Section on Radiology, California Medical Association
Secretary, Dr. Earl R. Miller, University of California Hospital, San Francisco, Calif.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets bi-monthly on second Thursday, at place selected by Secretary. Annual meeting in May.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. H. W. Ackemann, 321 W. State St., Rockford, Ill.

Radiological Section, Los Angeles County Medical Association
Secretary, Dr. Roy W. Johnson, 1407 S. Hope St., Los Angeles, Calif. Meets on second Wednesday of each month at the County Society Building.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Brooklyn Roentgen Ray Society
Secretary, Dr. Leo Harrington, 880 Ocean Ave., Brooklyn, N.Y. Meets monthly on fourth Tuesday, October to April.

Buffalo Radiological Society
Secretary, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

Chicago Roentgen Society
Secretary, Dr. F. H. Squire, 1754 W. Congress St., Chicago 12, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. D. D. Brannan, 11311 Shaker Blvd., Cleveland 4, Ohio. Meets at 6:30 P.M. at Allerton Hotel on fourth Monday each month, October to April, inclusive.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meetings held in Dallas on odd months and in Fort Worth on even months, on third Monday, at 7:30 P.M.

Denver Radiological Club
Secretary, Dr. Edward J. Meister, 366 Metropolitan Bldg., Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

Florida Radiological Society
Acting Secretary, Dr. Walter A. Weed, 204 Exchange Bldg., Orlando, Fla. Meetings in May and November.

Georgia Radiological Society
Secretary, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month at a place designated by the president.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. H. C. Ochsner, Methodist Hospital, Indianapolis. Meeting held the second Sunday in May annually.

Kentucky Radiological Society
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

Long Island Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

Michigan Association of Roentgenologists
Secretary, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Annette T. Stenstrom, 1218 Medical Arts Bldg., Minneapolis, Minn. One meeting a year at time of Minnesota State Medical Association.

Nebraska Radiological Society
Secretary, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. Hugh F. Hare, Lahey Clinic, Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

Radiological Society of New Jersey
Secretary, Dr. H. J. Perlberg, 921 Bergen Ave., Jersey City. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

New York Roentgen Society
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

NORTH DAKOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. J. E. McCarthy, 707 Race St., Cincinnati. Meets at time and place of annual meeting of Ohio State Medical Association.

PACIFIC ROENTGEN SOCIETY
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. L. E. Wurster, 416 Pine St., Williamsport. Annual meeting at Penn Alto Hotel, Altoona, Pa., May 13–14, 1944.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. R. P. Barden, University Hospital, Meetings first Thursday of each month from October to May inclusive at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY
Secretary, Dr. R. G. Alley, 4800 Friendship Ave. Meets second Wednesday each month, 4:30 P.M., October to June, Pittsburgh Academy of Medicine.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. Sidney Larson, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY
Secretary, Dr. A. M. Popma, 220 N. First St., Boise, Idaho.

ST. LOUIS SOCIETY OF RADIOLOGISTS
Secretary, Dr. E. W. Spinzig, 2646 Potomac, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September, at a place designated by the president.

SAN DIEGO ROENTGEN SOCIETY
Secretary, Dr. Henry L. Jaffe, Naval Hospital, Balboa Park, San Diego, Calif. Meets monthly on first Wednesday at dinner.

SAN FRANCISCO RADIOLOGICAL SOCIETY
Secretary, Dr. Martha Mottram, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., first six months of year at Toland Hall, University of California Hospital, second six months at Lane Hall, Stanford University Hospital.

SHREVEPORT RADIOLOGICAL CLUB
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

SOUTH CAROLINA X-RAY SOCIETY
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

TENNESSEE RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Herman Klapproth, Sherman, Texas.

UNIVERSITY OF MICHIGAN DEPARTMENT OF ROENTGENOLOGY STAFF MEETING
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Flanagan, 116 E. Franklin St., Richmond, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October through May, College Club, Seattle.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. J. M. Robinson, University of California Hospital. Meets monthly in evening on third Thursday.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month at 4:45 P.M. at the Royal Society of Medicine 1, Wimpole St., London, W. 1.

FACULTY OF RADIOLOGISTS
Secretary, Dr. M. H. Jupe, 32 Welbeck St., London, W. 1 England.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Secretary, Dr. A. D. Irvine, 540 Tegler Bldg., Edmonton, Alberta.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

SOUTH AMERICA

SOCIEDAD ARGENTINA DE RADIOLOGIA
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

CONTINENTAL EUROPE

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse Biel. Meets annually in different cities.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

AMERICAN COLLEGE OF RADIOLOGY

The Annual Meeting of the American College of Radiology will be held at the Stevens Hotel at 10:00 A.M. on Wednesday, June 14, 1944, during the week of the meeting of the American Medical Association. Fellows and members who are planning to attend should make hotel reservations immediately through the Housing Committee of the American Medical Association.

JOURNAL OF NEUROSURGERY

The new *Journal of Neurosurgery* which is to be published bimonthly for the Harvey Cushing Society, has, with the first issue, established itself proudly among the current medical journals. The hitherto hybrid neurosurgeon now has a journal of his own in which to publish his own peculiar triumphs, trials and theories. The well balanced selection of papers for the first issue is a tribute to the editorial management of Louise Eisenhardt. Dr. Cushing would indeed have been pleased with the varied contributions of his friends and pupils in the new journal and no doubt would even have smiled tolerantly at the name—*Journal of Neurosurgery*—his own preference being the term neurological surgery.

CHICAGO ROENTGEN SOCIETY

At the annual meeting of the Chicago Roentgen Society held on Thursday, April 13, 1944, the following officers were elected for the coming year: *President*, Dr. Warren W. Furey; *Vice-President*, Dr. T. J. Wachowski; *Secretary-Treasurer*, Dr. Fay H. Squire; *Trustees*, Dr. Earl E. Barth, Dr. Frank L. Hussey and Dr. Benjamin D. Braun.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Pudenz, Robert H. Repair of cranial defects with tantalum; experimental study. *J. Am. M. Ass.*, Feb. 13, 1943, *121*, 478–481.

Enthusiasm for the employment of the alloplastic materials has recently been revived by the encouraging reports of Geib, Beck and Peyton and Hall on the repair of cranial defects with vitallium. In this paper certain observations on the experimental and clinical use of tantalum for this purpose are reported.

Tantalum plates were implanted in the cranial defects of 11 cats. The operative procedures were carried out under sterile conditions using intraperitoneal soluble pentobarbital anesthesia. The animals were killed after periods of survival varying from twenty-seven to 318 days. There was no evidence of reaction to the metal during the observation period in any of the animals.

Results. In all the experiments the tantalum plates were enveloped in delicate translucent layers of connective tissue which were continuous with the pericranium. The capsule was completely formed at the end of twenty-seven days and showed no tendency to progressive thickening. Even at the end of 318 days, the bluish white luster of the metal was easily perceptible through the delicate layers of the capsule. These layers were tightly adherent to the tantalum plates and intracapsular fluid formation was absent. The inner layer was adherent to the dura but easily separable from it. When the capsules were opened the lining was invariably found to be smooth and glistening. Osteoblastic activity was not hindered, and even at the end of twenty-seven days the proliferating bone at the edge of the defect had closely approximated the edge of the metal. In the animals surviving 317 and 318 days there was a complete closure of the cranial defect by the new bone formation. Without exception, the tantalum plates retained their original luster and showed no signs of corrosion. An inflammatory reaction leading to extrusion or necessitating removal of the plates did not occur.—*S. G. Henderson.*

Kahn, Edgar A. Contrast media in cysts and abscesses of the cerebral hemisphere. *Surg., Gynec. & Obst.*, May, 1942, *74*, 983–990.

It has been the experience of all neurosurgeons in attempting ventricular air injection or biopsy of a cerebral tumor to enter unexpectedly a cystic cavity with the exploring needle, xanthochromic fluid or pus being obtained. To approach such a lesion in the most direct manner and thus simplify operative procedure, the use of a contrast medium is desirable. Air and iodized poppy seed oil have been used for this purpose but they do not mix with fluid contents. Sodium iodide is miscible but colloidal thorium dioxide (thorotrast) is less irritating, mixes readily and has the added advantage of being phagocytosed by the cellular elements of an abscess wall, making the capsule radiopaque.

Histories of cases are presented in an effort to show the value of colloidal thorium dioxide cystography. In an astrocytoma in a fourteen year old girl, the cyst was outlined showing the mural nodule attached to the anterior wall. Cushing long ago showed that if the mural nodule of an astrocytoma were removed the cyst wall need not be dealt with. Thus, in this case an effective operation was carried out by means of a comparatively simple procedure.

The author suggests that there might be wider application in the field of general surgery as in visualization of an empyema cavity by means of the thorotrast. In the drainage of a thoracic empyema, the difficulty increases as the cavity becomes smaller. It is at this later stage that the colloidal thorium dioxide which has been phagocytosed by the empyema wall might show when obliteration is complete.—*Mary Frances Vastine.*

NECK AND CHEST

Dockerty, Malcolm B., and Mayo, Charles W. Primary tumors of the submaxillary gland with special reference to mixed tumors. *Surg., Gynec. & Obst.*, June, 1942, *74*, 1033–1045.

Eighty-one primary submaxillary malignant tumors have been reviewed from the clinical

and pathological aspects. The results of the study are as follows:

1. True mixed tumors constituted 63 per cent of the series. They represented low grade, slowly growing adenocarcinomas usually not associated clinically with pain or local fixation. The tendency toward recurrence was not pronounced except when inadequate "tissue sacrifice" had been carried out.

2. Adenocarcinomas of the cylindroma type accounted for 18.5 per cent of the tumors. These cylindromas, as a rule, were associated with a short clinical history in which pain and local fixation were prominent features. Pathologically the lesions, although they were of a moderate degree of malignancy, presented pronounced infiltrative tendencies with selective invasion of nerves. The rate of recurrence was extremely high and the outlook generally unfavorable.

3. An "intermediate" group of cases was found in which the tumors pathologically shared the features of the mixed tumors and the cylindromas. Clinically, also, the histories of the patients justified separation of the tumors into a special category.

4. Eight patients, 9.5 per cent, had atypical tumors described as "miscellaneous." Prognosis depended partly on the type and grade of the lesion and partly on the extent of lymph node involvement.

5. Clinical follow-up studies have demonstrated the usefulness of the microscopic classification presented by the authors in relation to prognosis.

6. Throughout the study, the authors were impressed by the disappointing results which followed conservative operation on malignant tumors of the submaxillary gland.—*Mary Frances Vastine.*

WALKER, GEORGE A. Amyloid goiter. *Surg., Gynec. & Obst.*, Sept., 1942, *75*, 374–378.

There have been reports of 56 cases of amyloid goiter in the literature. The author reports 2 additional cases bringing the total to 58. The following conclusions have been made:

1. The commonest primary disease associated with amyloid infiltration of the thyroid is pulmonary tuberculosis. Purulent bronchitis with bronchiectasis or neoplastic processes are less commonly the precursors.

2. Amyloid infiltration of the thyroid may occur as a part of a primary amyloidosis.

3. Amyloid infiltration of the thyroid without amyloid in any other organ is a very rare phenomenon, only 2 such cases being found in the literature.

4. Amyloid infiltration of the thyroid gland causes enlargement and an increase in consistency in a majority of the cases.

5. Amyloid infiltration of the thyroid is sometimes associated with fat tissue infiltration as well. There is the possibility that this is more than a casual relationship.

6. In no case of thyroid amyloidosis has there been any evidence of thyroid insufficiency.

7. The most common error in diagnosis is to conclude that a malignancy is present when actually amyloid is responsible for the enlargement, increase in consistency and nodularity of the thyroid.—*Mary Frances Vastine.*

KING, WILLIAM L. M., and PEMBERTON, J. DEJ. So called lateral aberrant thyroid tumors. *Surg., Gynec. & Obst.*, May, 1942, *74*, 991–1001.

Fifty-four cases in which a benign or a malignant tumor of thyroid tissue was discovered in the lateral region of the neck without any gross connection with the thyroid gland itself are analyzed. The following conclusions are reached:

1. So-called lateral aberrant thyroid tumors are nearly always metastatic extensions to the deep cervical lymph nodes from primary carcinoma in the homolateral lobe of the thyroid gland.

2. Seventy-four per cent of these tumors are papillary adenocarcinomas and spread by lymphatic extension.

3. Sixty per cent of "lateral aberrant thyroid tumors" are associated with thyroid tumors of identical structure which are always situated on the same side.

4. The "aberrant" tumors should be treated by radical block dissection of the neck and removal of the corresponding thyroid lobe whether or not a tumor can be felt or seen in that lobe at the operating table.

5. Complete removal of all nodes and thyroid tissue known to be involved is essential if recurrence is to be prevented. Treatment by radiation is of questionable benefit unless surgical removal of the diseased tissue has been complete.

6. Following complete surgical removal the prognosis is good in cases of papillary and low grade non-papillary carcinomas because the rate of growth of these lesions is very slow and these tumors do not commonly invade sur-

rounding structures; in the inoperable or neglected cases, they may have little effect on the patient's general health for years but they may eventually cause death.—*Mary Frances Vastine.*

Elkeles, A. A case of the Plummer-Vinson syndrome with radiologically demonstrable peptic ulcer of the oesophagus. *Brit. J. Radiol.*, April, 1942, *15*, 122–123.

Dysphagia associated with hypochromic microcytic anemia constitutes the so-called Plummer-Vinson syndrome. Roentgen examinations have shown that the dysphagia is not functional, as was at first believed, but that there are organic changes consisting of atrophic changes in the mouth, glossitis and a post-cricoid web.

A case is described in a woman of fifty-two and illustrated with a roentgenogram. In addition to the above-mentioned changes, there were spasm and niche formation at the cardiac end of the esophagus, indicating peptic ulcer. The blood count showed pernicious anemia and stomach examination showed achlorhydria. She improved on liver injections and iron.

It is probable that, in addition to the ordinary type of pernicious anemia, there is a type that develops from hypochromic microcytic anemia and the dysphagia in these cases may be due, partly at least, to a deficiency of iron. No case of peptic ulcer at the cardiac end of the esophagus has been reported previously in the Plummer-Vinson syndrome. This case shows the advisability of making a careful examination of the whole esophagus.

It is possible that the organic changes in this syndrome may be precancerous, in analogy with the findings in chronic gastritis with achlorhydria.—*Audrey G. Morgan.*

Sparks, J. V., and Scrimgeour, D. Muir. Transposition of the aortic arch; report of three cases. *Brit. J. Radiol.*, May, 1942, *15*, 150–153.

Three cases of transposition of the aortic arch are described and illustrated with roentgenograms. This abnormality is very rare. In the first 2 cases the aortic arch developed from the fourth right arterial arch and an aortic diverticulum formed at the termination of the arch on the left. In the third case the aortic knuckle shadow was prominent to the right of the sternum.

This is the easiest of all the congenital anomalies of the circulatory system to diagnose and the importance of recognizing it is illustrated by a case described by Dr. Hope Gosse in which he was able to prevent a patient from being treated by irradiation for a mediastinal tumor and by Case III of this group in which an exploratory thoracotomy had been carried out before the patient was examined by the authors.—*Audrey G. Morgan.*

Barclay, A. E., Franklin, K. J., and Prichard, M. M. L. The mechanism of closure of the ductus venosus. *Brit. J. Radiol.*, March, 1942, *15*, 66–71.

The authors studied the closure of the ductus venosus on mature lambs obtained by cesarean section. Diagrammatic sketches and roentgenograms of the region are given illustrating their findings. They used direct and indirect roentgen cinematography combined with intravascular injections of radiopaque medium made into one of the veins of the umbilical cord. They found roentgen evidence of a sphincter or similar structure at the beginning of the ductus venosus and concluded that this structure must bring about the functional closure of the ductus. They then made dissections and found anatomical evidence also of the existence of such a structure. The question is now being studied by two histologists, one in England and one in the United States, and so far their results are the same and justify the authors' conclusion that the smooth muscle at the beginning of the ductus venosus is concerned with the functional closure of the channel. Their report will be published later.—*Audrey G. Morgan.*

Tucker, William B., and Bryant, J. E. The problem of unsuspected tuberculosis during pregnancy in the Negro; incidence by roentgenologic techniques in 1,000 consecutive cases. *Am. J. Obst. & Gynec.*, April, 1943, *45*, 678–685.

One thousand consecutive patients attending the Prenatal Clinic of the Provident Hospital and Training School in Chicago were examined for pulmonary tuberculosis by roentgenoscopy and roentgenography. (1) Eighteen cases (1.8 per cent) of unsuspected clinically important tuberculosis and 11 additional cases (1.1 per cent) of clinically unimportant reinfection tuberculosis, a total of 29 cases (2.9 per cent), were found. This incidence was found to be approximately the same as for other non-pregnant women of the same age groups examined at the Provident Hospital. (2) The incidence of un-

suspected clinically important tuberculosis at the Chicago Lying-in Hospital was found to be 1.0 per cent by Eisele *et al.* The difference in the figures between the two hospitals is probably due to the different economic and social status of the two groups rather than to race or a slight difference in the age distribution between the two groups. (3) The findings serve to confirm the contention that routine chest roentgenologic examinations should be an indispensable part of the prenatal care of pregnant women.—*Mary Fran ces Vastine.*

HORSLEY, J. SHELTON. Pulsating tumors of the anterior mediastinum. *Surg., Gynec. & Obst.*, July, 1942, *75*, 49–53.

A case is reported in which a tumor was removed from the anterior mediastinum behind the upper manubrium. Pulsation evidently transmitted from the aorta through the tumor had eroded the upper sternum. The defect was smooth in outline. The tumor was thought to be malignant and probably a metastatic hypernephroma. However, a primary lesion could not be found and the patient was found to be perfectly well at the last follow-up two years after the removal of the mass.

A neoplasm arising in the anterior mediastinum and eroding through the sternum by transmitted pulsation from the aorta is extremely rare. Crile has reviewed 13 cases of pulsating neoplasms of the sternum and has added 5 from the records of the Cleveland Clinic. Of this group, 9 were probably cases of metastatic hypernephroma and 9 were probably metastases from malignant adenoma of the thyroid.

The possibility of this lesion being a Pancoast tumor is discussed. These tumors are located in the posterior thoracic inlet adjacent to the pulmonary apex (the superior pulmonary sulcus). The site of origin in independent of lung, pleura, ribs, vertebrae, mediastinum or metastatic foci. Pancoast believed that they arose from a persistent rest from the ectodermal portion of the branchial structures. Horner's syndrome is produced. (This should really be called Hare's syndrome since Hare described this symptom complex thirty-one years before Horner.) There is pain which is referred to the shoulder and arm associated with muscle atrophy. The roentgenogram shows a small homogeneous apical shadow and is suggestive of destructive infiltration of contiguous ribs and vertebrae.—*Mary Frances Vastine.*

HEAD, JEROME, and HUDSON, THEODORE R. Subphrenic abscess with bronchial fistula. *Surg., Gynec & Obst.*, July, 1942, *75*, 54–60.

It is observed that hepatic, subdiaphragmatic and perinephritic abscesses frequently perforate the diaphragm and are evacuated by expectoration. Collections of pus in the upper abdomen frequently burrow upward through the diaphragm whereas similar collections in the thorax rarely, if ever, extend downward into the abdomen. The incidence of perforation of the diaphragm is so high in subdiaphragmatic abscess that this complication is to be expected when operation is too long delayed.

Next to the history, the roentgenogram gives the most important diagnostic information in this condition. The most characteristic finding is a greater or lesser elevation of the diaphragm with air and a fluid level beneath it. Neither the elevation nor the air and the fluid level are always present. There may be no more than evidences of old pleurisy at the base. The findings in the lungs and pleura above the diaphragm vary greatly. The perforation may have produced an empyema as well as a bronchial fistula. In acute cases there may be extensive bronchopneumonia in the lower lobe on the affected side. In more chronic cases, areas of chronic pneumonitis may be present in one or both lungs. Not infrequently pulmonary and pleural findings are almost entirely absent, consisting merely of increased peribronchial markings extending into one lower lobe. The meagerness of thoracic findings in the presence of fever and copious expectoration is one of the important diagnostic points. In such cases it is necessary to employ bronchography to rule out bronchiectasis. However, when this has been done and one is still unable to explain the abundant expectoration on the basis of revealed pulmonary or pleural pathema, it is well to consider the possibility that the pus is coming from below the diaphragm.

Roentgenograms taken after the injection of 300 to 400 cc. of air into the peritoneal cavity are of great value. Under normal conditions with the patient in the upright position, these will reveal air beneath both halves of the diaphragm. In the presence of subdiaphragmatic abscess, no air can penetrate into this space on the affected side. If the under surfaces of the diaphragm are free, pus in this region can be ruled out.—*Mary Frances Vastine.*

Gosse, A. Hope. A case of hydatid disease of the lungs. *Brit. J. Radiol.*, March, 1942, *15*, 92–93.

A case of roentgen and laboratory diagnosis of hydatid cyst of both lungs is reported which is considered interesting because of the rarity of the disease in England. The patient was a laborer, aged thirty-two, who came for examination on account of a history of hemoptysis. In March, 1939, he was treated for bronchopneumonia and from the roentgenogram made at that time a diagnosis of abscesses of the lungs was made. Apparently at that time he had a cyst at the base of each lung. When he came to the hospital in 1941 because of hemoptysis, the roentgenogram showed a circular shadow at the left base of homogeneous density surrounded by normal lung tissue. At the right base there was infiltration, some fibrosis and a small area suggestive of loss of lung tissue. This roentgenogram is reproduced. Examination of the sputum showed a fragment of white membrane about the size of a postage stamp which evidently came from the lining of a cyst. The patient said he had coughed up bits like that for a week but never before that.

The diagnosis of hydatid cyst of the left lung and cyst of the right lung ruptured into a bronchus was based on the two roentgenograms, the presence and appearance of the expectorated membrane, an eosinophilia of 8 per cent, the positive intradermal Casoni reaction and ten years' residence in India.—*Audrey G. Morgan.*

Winn, William A. Pulmonary cavitation associated with coccidioidal infection. *Arch. Int. Med.*, Dec., 1941, *68*, 1179–1214.

Cavitation heightens the close similarity between the roentgen appearances of coccidioidal and tuberculous pulmonary infections; without identification of the causative organism diagnostic confusion may occur. Coccidioidal cavitation usually develops during, or shortly after, the primary stage of pulmonary infection; it is far more benign than tuberculous cavitation as demonstrated in the 13 cases reported in this paper. In cases of primary coccidioidal cavitation the prognosis is entirely favorable; prolonged institutional care is unnecessary; early return to usual occupation despite persistence of a pathologically latent cavity is permitted; definitive collapse procedures to close such cavities are avoided except for possible performance of pneumothorax if hemoptysis is frequent or massive or if the cavitation exhibits a more active phase than the thin-walled cavities described here.

The acute infection is *not* transmitted from person to person via sputum containing the endospores; hence, patients with coccidioidal infection are not considered a menace to society. The disease is endemic in the San Joaquin Valley and near-by valleys in central California, parts of Arizona and Texas and the Chaco regions of Argentina. In such areas the infection is widespread, as indicated by positive skin reactions to coccidioidin by a large proportion of San Joaquin Valley residents. Evidence of such widespread infection is difficult to obtain by an ordinary roentgen examination of the chest, with probable exception of calcification.

Residual pulmonary cavitation is regarded as only an infrequent manifestation of the primary coccidioidal infection, although in an unknown number of cases these cavities close spontaneously. Coccidioidal granuloma remains a relatively uncommon disease; pulmonary cavitation associated with it is unusual and should be easily distinguishable from the cavitation in primary coccidioidal infection. In the latter, severe constitutional symptoms are strikingly absent despite the existence of pulmonary cavitation, hemoptysis or spherule-laden sputum.

The primary infection by *Coccidioides immitis* is commonly accompanied by symptoms of bronchitis with a slightly productive cough, malaise, anorexia, chills, fever, headache, backache, night sweats and pleurisy (organisms may be recovered from the occasional effusion as well as from the sputum). Roentgen studies of the chest "may reveal only changes in the area of the lung root, such as peribronchial haziness, or there may be definite patches of pneumonitis, which often assumes a nodular form. Occasionally, exudative lesions involving lobules, or even entire lobes of the lung, are present and may be associated with early cavitation. Recovery is followed by a walling off or clearing of the primary focus without complication. Evidence of the first infection may remain and be revealed in the roentgenogram in the form of localized caseous or calcified foci or cavitation." Cutaneous sensitivity to coccidioidin develops seven to fourteen days after such infection; erythema nodosum or multiforme occurs in 2 to 5 per cent of cases. Primary infection with few or no symptoms also occurs.

Residual coccidioidal pulmonary cavitation may be asymptomatic after the acute primary

infection has subsided. Cavitation in conjunction with the acute primary infection alters the above clinical picture very little; most of such patients do give a history of hemoptysis, however. The term "latent" has been applied to residual cavities to indicate that the process is no longer progressive. "Healed" would be a misnomer since these cavities harbor viable organisms of *C. immitis*. Criteria for the diagnosis of latent cavitation were based on roentgenographic appearance of a thin-walled cavity, which appeared "punched out" or "dead," with little or no surrounding collateral reaction. A history of hemoptysis, lower respiratory tract infection and slightly productive cough was usually obtained. Intracutaneous coccidioidin skin tests yielded positive results; sputum or gastric content contained *C. immitis*. In no case did follow-up (few months to several years) studies reveal dissemination or progression of the disease.

The latent coccidioidal cavities are "considered as more or less benign, stabilized structures which are the end-results of a small focus of destruction produced by the primary coccidioidal infection." Bronchial communications may be large or small. Detailed case reports with associated roentgenographic studies of 12 cases of latent cavitation and 1 case of bronchiectasis due to coccidioidal infection are included.—*Henry G. Moehring.*

Kerley, Peter. Wounds of the diaphragm. *Brit. J. Radiol.*, April, 1942, *15*, 97–99.

Diaphragmatic hernia is a frequent sequela to gunshot wounds of the thorax and abdomen. Many of these cases were overlooked in the last war. A case is described which suggests that the diagnosis can be made by careful roentgen examination.

The patient was a man, aged thirty-five, admitted to hospital fourteen hours after being injured by a bomb. There was a wound of the head and one of the chest with fracture of the sixth left rib posteriorly and a large bomb fragment in the lower lobe of the partially collapsed left lung. The whole of the lung was relatively opaque, indicating hemorrhagic atelectasis. Suspicion of an injury of the diaphragm was raised by the absence of a fluid level and of a clear diaphragmatic shadow. Operation showed that the diaphragm had been torn. The missile was extracted and the lung and diaphragm sutured. After a period of bronchopneumonia the patient recovered.

The roentgen findings which indicate injury of the peritoneum are: invisibility of the injured dome; intermittent twitching movements visible on the screen; the presence of a pneumoperitoneum if the wound is thoracic; an extensive wound of the lung with hemorrhagic atelectasis and little blood in the pleural cavity.

As these patients are usually most comfortable in the semi-recumbent position much of the blood drains into the abdominal cavity, which accounts for the absence of a fluid level. —*Audrey G. Morgan.*

Rives, James D. Anatomy and surgery of diaphragmatic hernia. Editorial. *Surg., Gynec. & Obst.*, May, 1942, *74*, 1026–1028.

The diaphragm is something of an afterthought in the evolutionary process, being present as a complete septum only in mammals. The major part of it is assembled from three ill-assorted structures—the septum transversum, the pleuroperitoneal membranes, and the dorsal mesogastrium. These structures descend from the cephalic portion of the celomic cavity on different time schedules and finally unite to form a single complete septum between the abdominal and thoracic cavities at about the seventh or eighth week of fetal life. Obviously, any disturbance of the orderly progress of this intricate process may result in the formation of defects in the diaphragm.

The phrenic nerve develops and descends with the segment formed from the septum transversum and invades the remainder of the diaphragm after fusion of the three segments. If this invasion is arrested prematurely, the musculature of that part of the diaphragm that has not received a nerve supply probably undergoes atrophy, leaving only the peritoneum and the pleura to separate the two great body cavities in that particular location.

Soon after the diaphragm becomes a complete septum, the mid-portion of the celomic cavity is rapidly expanded by growth of the liver, and the resulting tension of the diaphragm causes it to pick up from the body wall a supplementary rim of tissue. One would, therefore, expect the diaphragm to be continuous with the inner layer of the abdominal cavity. Recent anatomical studies by Baker have shown that this is actually the case. The anterior and lateral portions of the diaphragm are continuous with the transversus abdominis muscles and the posterior sheath of the rectus muscles. The attachment of these structures to the costal

arch is by means of what is, in effect, a common aponeurosis. Likewise the posterior or lumbar segments of the diaphragm are continuous with the anterior layer of the lumbodorsal fascia, except for the central portion, which is attached to the bodies of the lumbar vertebrae.—*Mary Frances Vastine.*

ABDOMEN

Cordiner, G. R. M. Duodenitis. *Brit. J. Radiol.*, Feb., 1942, *15*, 33–38.

Until recently chronic duodenitis has not been recognized as a clinical entity. Kirklin was the first to describe the roentgen appearance of this disease in a series of 32 cases which were proved histologically. His signs, however, may be absent in frank cases of duodenitis and the direct roentgen signs based on examination of the mucosal relief are of prime importance in the diagnosis of the disease.

One of the most important signs is broadening and thickening of the mucosal folds with a corresponding broadening of the hollows between them. To justify a diagnosis of duodenitis the folds must also show changes in their consistency. They show loss of flexibility, decreased movement on palpation and are less easily smoothed out by pressure and stretching. Sometimes the folds are so stiff that they appear to be rigid anatomical structures. The stiffening resembles that which takes place in a starched garment. The caliber of the swollen and stiffened folds is not uniform. But in some cases the relief pattern consists of fine, irregular elevations and depressions which are easily smoothed out by compression. The changes, which are generally localized in the cap, may extend into the descending portion of the duodenum. As a rule, erosions cannot be detected on the roentgenogram.

Roentgenograms are given showing the normal appearance of the duodenal mucosa and the various pictures seen in duodenitis.—*Audrey G. Morgan.*

Wolfer, John A., Beaton, Lindsay E., and Anson, Barry J. Volvulus of the cecum. *Surg., Gynec. & Obst.*, April, 1942, *74*, 882–894.

Over 300 cases of volvulus of the cecum have been reported in the international literature. This is a condition, therefore, which should be kept in mind in the differential diagnosis of disease presenting in the right lower quadrant of the abdomen and in the differential diagnosis of intestinal obstruction.

Volvulus of the cecum is defined as torsion limited to the cecum and adjacent terminal ileum and ascending colon.

The authors studied 125 normal adult cadavers consecutively and made the following observations: (1) In 11.2 per cent the cecum is mobile enough to allow the development of volvulus. (2) The anatomical arrangement which best predisposes to cecal volvulus is believed to be one in which the cecum is free and the ascending colon is fixed somewhere along its vertical course.

Incidence of Volvulus. Volvulus is most prone to occur in males in the twenty to forty year age group.

Etiology of Volvulus. The inciting agent of this disease may be purely mechanical or may be due to as yet incompletely understood physiological faults in the complex functioning of the right colon.

A case of cecal volulus is reported. A study of this case serves to emphasize the necessity for prompt surgical care and the importance of early examination by roentgenographic means.—*Mary Frances Vastine.*

Berne, Clarence J. Diagnosis and treatment of amebic liver abscess. *Surg., Gynec. & Obst.*, Aug., 1942, *75*, 235–238.

In 1931 it was found that the mortality in amebic liver abscess at the Los Angeles County Hospital was 85 per cent. Since 1931, 74 cases of amebic abscess have been recognized and these cases furnish the basis for this report.

Diagnosis. (1) Amebic infection of the colon always antedates the liver lesion but many cases of amebic colitis are clinically silent. In less than half of the cases was diarrhea present. (2) The stool usually contains cysts, trophozoites, or both. (Stool examinations were done on 55 patients with positive results in 40.) (3) The disease usually occurs in men. (There were 69 men and 5 women in this series.) It rarely occurs in patients under twenty years of age. (4) Trauma seems to activate a latent infection of the liver. (5) Instead of being chronic, the process was an acute one in 58 per cent of the cases. (6) In 33 per cent of the cases abdominal features were absent or minimal and the clinical phenomena were pulmonary because the abscess was located in the dome of the liver. (7) Hepatomegaly is a constant feature. Even with dome abscess there is often downward en-

largement. (8) Roentgen study will reveal the phrenic or transphrenic effects when the abscess is superior. The most characteristic changes are anterior and medial in the lower right chest. Elevation and immobility of the diaphragm are the earliest findings. Pneumonitis or pleuritis alone or in combination occurs as the lesion progresses. (9) Night sweats are frequent in the chronic cases and in the acute cases, chills are outstanding.

Treatment. The primary basis for cure is emetine in sufficient dosage. The author gives 1 grain daily for six doses, then a rest for six days after which the course is repeated as necessary.

Results of Treatment. (1) Nineteen patients (approximately 26 per cent) were cured by means of treatment with emetine alone. (2) Eighteen patients (approximately 24 per cent) were cured by means of emetine together with aspiration. (3) Surgery was done in 26 cases, 14 of which were adequately treated with emetine. The mortality was 53 per cent. This means that 12 cases were cured by surgery, some with and some without emetine.—*Mary Frances Vastine.*

Shepard, V. Duncan; Walters, Waltman, and Dockerty, Malcolm B. Benign neoplasm of the gallbladder. *Arch. Surg.*, July, 1942, *45*, 1–18.

Benign tumors of the gallbladder are so rare that very few of them are seen even in a large surgical practice. Therefore, the authors have studied 150 cases seen at the Mayo Clinic from January 1, 1916, to December 31, 1938. They include 45 cases of polyps, 103 of adenomyoma and 2 of fibroma. All of these tumors occur in middle life, the most frequent incidence being in the fifties. Polyps and adenomyoma each occur in approximately 1 out of 100 gallbladders removed on operation.

These benign tumors are not found in gallbladders that are otherwise normal. In all these cases there were some signs of chronic inflammation and there were stones in more than half of them. The inflammation and the irritation caused by the stones are probably factors in causing the tumors. There is evidence that in some cases they may be due to displaced remnants of embryonic tissue.

The clinical symptoms of these tumors are not characteristic. The symptoms and physical findings are those of the accompanying cholecystitis or cholelithiasis. The only means of making a diagnosis before operation is by cholecystography. There is a clear defect in the shadow of the dye-filled gallbladder that is more radiolucent than that of the most radiolucent non-opaque stone.

These tumors rarely undergo malignant degeneration. Such changes were seen in only 2 of the cases of polyps and in none of the cases of adenomyoma or fibroma. But intramural abscess or intramural stone may occur in adenomyoma. Because of the possibility of these changes and of malignant degeneration and the frequency of inflammation and gallstones all gallbladders containing benign tumors should be removed.—*Audrey G. Morgan.*

Pearse, Herman E. Whipple's disease. (Editorial) *Surg., Gynec. & Obst.*, Aug., 1942, *75*, 268–269.

In 1907 Whipple described a disease which was "characterized anatomically by deposits of fat and fatty acids in the intestinal and mesenteric lymphatic tissues," and which he termed intestinal lipodystrophy. This disorder caused loss of weight to the point of emaciation; loss of strength; microcytic anemia; recurrent arthritis; doughy swelling of the abdomen associated with tenderness and gaseous distention; abdominal pain and fatty diarrhea with an average of three or four stools a day. They were light or clay colored and consisted of over 50 per cent fat and fatty acids by weight. There was no interference with fat splitting for the fat in the stool was almost completely composed of split fat and soaps in crystalline form.

The disease is rare. The symptoms together with roentgen changes in the intestinal pattern may lead to a diagnosis of partial intestinal obstruction. It has been found that with adequate dosage of bile salts the symptoms disappear, appetite and strength return, weight is gained, vitamin A absorption improves and the fat content of the stool approaches normal.—*Mary Frances Vastine.*

Johnston, Charles G. "Gas pains?" (Editorial) *Surg., Gynec. & Obst.*, Nov., 1942, *75*, 668–669.

The early recognition of ileus, whether occlusive or non-occlusive in type has long been recognized as being of importance in the control of mortality from this condition. It is to be remembered that it is not rare for patients with bowel obstruction to have some diarrhea, and

passage of gas or feces is not uncommon. There is but one laboratory finding of importance in the diagnosis of ileus and that consists of a flat roentgenogram of the abdomen. This is a simple painless laboratory procedure which yields rapid and definite data regarding the presence of gas in the small bowel long before abdominal distention is evident.—*Mary Frances Vastine.*

Levitin, Joseph, and Trauner, Lawrence M. A roentgenological study of the postoperative abdomen. *Surg., Gynec. & Obst.*, Oct., 1942, *75*, 510–514.

Distention frequently develops in twenty-four to ninety-six hours following abdominal surgery. A certain percentage of these cases are of a mechanical obstructive nature and not a paralytic ileus brought on by stimulation of the sympathetic nerves. These two conditions can be differentiated by a simple roentgen examination of the abdomen. The differential factors include: (1) a continuous distention to the point of obstruction in mechanical obstruction; scattered loops of distended small and large bowel in paralytic ileus; (2) loops few and large in mechanical obstruction; loops many and small in paralytic ileus; (3) dynamic appearance of bowel in mechanical obstruction; adynamic appearance of bowel in paralytic ileus.

This study is based on 107 cases from three sources of material. The conclusions reached from a study of these 3 groups are as follows:

1. Group 1. Unselected cases studied after operation.
   a. Distended bowel of a paralytic nature followed abdominal surgery in 75 per cent of cases.
   b. The roentgen findings of distention usually appeared on the first postoperative day and lasted three days.
   c. The type of anesthesia used seemed to play no part.
   d. Mechanical small bowel distention can exist without symptoms.
2. Group 2. Cases entering the hospital with abdominal distention and suspected bowel obstruction.
   a. Causes of mechanical obstruction in 29 cases included: adhesions 5, carcinoma of colon 5, volvulus 4, carcinoma implants 3, appendiceal abscesses 3, internal hernia 3, ileocolic intussusception 2, intussusception of Meckel's diverticulum 1, gallstone impacted in terminal ileum 1, perforated bladder 1, mesenteric adenitis 1.
   b. Causes of paralytic ileus in 6 cases included: acute appendicitis 2, perforated duodenal ulcer 1, inguinal hernia 1, bleeding follicular cyst 1, mesenteric thrombosis 1.
   c. The absence of roentgen findings of distention does not rule out a severe bowel pathological lesion. This is especially true in cases of strangulated bowel.
3. Group 3. Cases of postoperative distention not included in Group 1.
   a. All cases of the abdomen examined roentgenologically will not fit into one of the three groups of mechanical obstruction, adynamic ileus, or no distention. For instance, there may be a combination of local ileus and mechanical block.
   b. The use of the Miller-Abbott tube is not advised for the patient entering the hospital with a low intestinal obstruction. It is recommended for use in the patient with postoperative distention.—*Mary Frances Vastine.*

GYNECOLOGY AND OBSTETRICS

Hastings, W. H. Pelvimetry simplified. *Brit. J. Radiol.*, April, 1942, *15*, 114–121.

In measuring the diameters of the female pelvis by roentgenometric methods, the first essential is to determine the height of the diameter to be measured above the film at the time of exposure. Once this is known the question is one of simple proportion. A method is described in which two exposures are made on the same film with a double shift of the tube of 1½ inches to either side of the midline, the total shift being exactly 3 inches. The patient need not hold her breath but must not move until the second exposure is completed. The focus-film distance is 30 inches.

Based on this focus-film distance and shadow shift, a table, which is reproduced, has been worked out, showing the heights of the various points corresponding to the different measurements of their shadow shifts. With this and a simple chart made out on squared graph paper of a scale of 1 inch to the square, subdivided vertically and horizontally into tenths of an inch, the true diameter can be read off immedi-

ately after measuring the shadow shift and the distance between the bisecting points of the shadow shifts of the two ends of the diameter and after referring to the table of heights. The chart is also reproduced. The computation can be made accurately in a few minutes for all diameters and angles of the pelvis without any arithmetical calculations.—*Audrey G. Morgan.*

Rosenberg, Maximilian, and Schenck, Samuel B. Gestation fourteen years after radium induced amenorrhea. *Am. J. Obst. & Gynec.*, June, 1942, *43*, 1033–1035.

A white woman, aged forty-seven, was admitted with a history of backaches for six months and amenorrhea for fourteen years following radium therapy. She appeared acutely ill. She had received 1,200 mg-hr. of radium when she was thirty-three years of age because of menorrhagia and metrorrhagia. (Several months prior to this, a therapeutic abortion had been performed for pernicious vomiting of pregnancy.) At the time of the present admission a diagnosis of submucous fibroid was made as the uterus was found to be the size of a three months pregnancy. A supracervical hysterectomy was done and the pathologic diagnosis was that of a gravid uterus with placental tissue.—*Mary Frances Vastine.*

Hirsch, J. B., and Hirsch, J. B., Jr. Normal infant and a sympus monster with a short cord in a twin pregnancy. *Am. J. Obst. & Gynec.*, May, 1943, *45*, 889–891.

There are many records of sympus monsters in the literature but this case is unusual in the occurrence of such a monster in a twin pregnancy.

Roentgen findings on the monster: (1) thirteen ribs on left side; 12 ribs on the right; (2) angle of mandible absent on right side; (3) impression of complete spina bifida although the spinous processes were normal in number; (4) coccyx anterior to femur; (5) pelvis consisting of a right and left os ilium which were asymmetrical with a heart-shaped bone between them; (6) no real hip joint but two femurs were somehow articulated on each side between the heart-shaped bone and the ilia; (7) fusion of lower extremities with two femurs, two tibias, and one fibula. (8) some separation distinguishable between the soft parts of the femurs but not between the tibias; (9) only one foot which projected at a right angle from the distal end of the left tibia. One tarsal bone, six metatarsals and six phalanges were present.—*Mary Frances Vastine.*

Rice, Maurice, Pearson, Bjarne, and Treadwell, W. B. Malignant lymphangioma of the ovary. *Am. J. Obst. & Gynec.*, May, 1943, *45*, 884–888.

A case of an apparently morphologically benign lymphangioma of the ovary is presented in which a resection was done. Six months later, a local recurrence with peritoneal dissemination and hepatic metastasis had taken place and a new growth in the opposite ovary was present. A marked morphologic difference was evident between the primary and disseminated neoplasm consisting of proliferation of the endothelium and changes in the individual cells. However, because of the marked necrosis of the primary together with the marked hepatic necrosis present at autopsy, the authors feel that this tumor was malignant at its inception in spite of the regular benign morphology it presented.—*Mary Frances Vastine.*

Taussig, Fred J. Iliac lymphadenectomy for group II cancer of the cervix. *Am. J. Obst. & Gynec.*, May, 1943, *45*, 733–748.

From 1930 to October, 1942, the author and his associates have done 175 iliac lymphadenectomies. The author is convinced that in group II cancers of the cervix as an addition to the thorough irradiation of the primary tumor, iliac lymphadenectomy is of definite value.

The preferred plan of procedure is as follows: (1) A course of roentgen therapy four times a week for about four or five weeks is given through six portals, two anterior, two posterior and two perineal. A tumor dose of 2,500 to 3,000 r is delivered. The midline area where the operative incision is to be made is protected during treatment. (2) Operation (i.e., inguinal lymphadenectomy) is performed two weeks following termination of the roentgen treatment. (3) Radium treatment is given eleven to fourteen days following the operation. A dosage of 5,000 to 6,000 mg-hr. is delivered. The application is made from five to six points (corpus, cervical canal, against the cervix, in the vaginal fornices), using a total of 125 to 135 mg. in 0.5 mm. platinum for forty to forty-five hours.

The author summarizes his work as follows: (1) One hundred and seventy-five cases of group II cervical cancer were subjected to iliac

gland removal with irradiation of the primary tumor. The operative mortality was 1.7 per cent with a mortality of 0.7 per cent in the last 140 cases.

(2) The five year survival rate of 70 cases operated on previous to October, 1937, was 38.6 per cent. This is to be compared to a five year survival of 22.9 per cent in 118 similar cases treated by irradiation alone.

(3) Cancer was found to be present in the lymph glands in 26.8 per cent of the 175 cases operated upon. Even in those cases with demonstrable metastases, a five year salvage of 21 per cent was obtained.—*Mary Frances Vastine.*

Mezer, Jacob. Metaplasia and carcinoma in cervical polyps. *Surg., Gynec. & Obst.*, Aug., 1942, *75*, 239–244.

A cervical polyp is simply a localized heaping up of normal cervical tissue. Cervcial polyps appear most frequently in the fifth decade and in parous women.

One thousand six hundred and thirty-six polyps were studied at the Free Hospital for Women in Brookline, Mass. It was concluded that: (1) cervical polyps are frequently found in gynecological patients; (2) a third of the polyps studied were subject to squamous metaplasia, or "epidermization," which is neither a precancerous nor a malignant process; (3) 5 cases of carcinoma which arose in cervical polyps are cited among the 1,636 polyps studied (an incidence of 0.03 per cent); (4) cervical polyps should be removed and their bases cauterized; (5) in cases of abnormal bleeding, other causes should be ruled out by means of careful pelvic examination before the cervical polyp is accepted as the only cause of the bleeding.—*Mary Frances Vastine.*

Glass, Morris, and Goldsmith, Joseph W., Jr. Fibroma of the ovary associated with ascites and hydrothorax (Meigs' syndrome). *Am. J. Obst. & Gynec.*, June, 1942, *43*, 1048–1054.

In 1923, Owen and Horn described the association of an ovarian fibroma with hydrothorax and ascites. Meigs and Cass in 1937 called attention to this clinical entity and they emphasized the fact that such cases could be cured by removing the ovarian tumor in spite of the grave appearance of the patient.

Eighteen cases of Meigs' syndrome have been previously reported. The authors report this, the nineteenth case, in a woman seventy-three years of age. The patient was hospitalized with symptoms which caused a diagnosis of cardiac decompensation to be made. Roentgenograms of the chest revealed a pleural effusion on the right extending to the sixth rib in the axillary line. Bomze and Kirschbaum point out that many of these patients have been hospitalized for symptoms suggestive of heart failure. The reason for the fluid accumulation is not known. It has the physical and chemical characteristics of a transudate. The pleural fluid is more frequently found in the right chest cavity. Following removal of the ovarian tumor, the fluid spontaneously disappears although it rapidly re-accumulates following thoracentesis or paracentesis before removal of the neoplasm.—*Mary Frances Vastine.*

Folsom, Alfred I., and O'Brien, Harold A. The female obstructing prostate. *J. Am. M. Ass.*, Feb. 20, 1943, *121*, 573–580.

In 1931, Folsom first emphasized the clinical importance of the group of glands surrounding the posterior part of the female urethra. He felt then, and the writers feel now, that an infection harbored through the years in these glands is probably the cause of the bizarre pathologic picture seen in this portion of the female urethra. Prostatism is a clinical entity that is seen much more frequently in women than is recognized and properly treated.

Clinically these cases present, in addition to a bladder irritation, some degree of difficulty in voiding. This varies from simply a sense of obstruction and unfinished business on through varying degrees of obstruction to complete retention. A plain cystogram, either air or sodium iodide being used, will frequently reveal a filling defect in the region of the internal orifice similar to the defects seen in men with prostatic hypertrophy. On cystoscopic examination one may find a normal bladder wall or a grossly trabeculated wall with cellules and even diverticula and calculi. Not infrequently the bar or collaret may be felt by palpating the urethra through the vagina with the cystoscopic sheath in place. The majority of the cases show a fibromuscular hypertrophy with fibrous hyperplasia and varying grades of inflammatory reaction. In some cases actual gland structures have been reported, and these seem to be identical with similar lesions in the male.

The treatment of this condition (trans-

urethral resection) is described, and 7 case histories are given.—*S. G. Henderson.*

Ehrlich, H. E., and Horowitz, E. A. Benign papillary epithelioma of the vulva. *Am. J. Obst. & Gynec.*, May, 1943, *45*, 879–884.

A case of benign papillary epithelioma is described and 4 similar authentic cases are collected from the literature. The characteristics of this tumor include the following: (1) It occurs as a single, round or ovoid mass whose surface is papillary and nonulcerated. (2) It is attached to the labia or mons veneris by a short pedicle or it may be sessile. (3) Unlike condyloma acuminatum, it occurs as a single growth, reaches appreciable size and is not associated with a foul odor. (4) Histologically, it differs from the venereal wart by the presence of intense keratosis and parakeratosis, absence of edema of the epiderm, but little stigma of inflammation, and a connective tissue stroma that is not congested. (5) The benign epithelioma of the vulva does not recur after operative removal. (6) Carcinoma-like condylomas of the penis have been described. These have been regarded as benign and are characterized by a downward infiltration of the epithelium. Such a picture is strikingly absent in benign papillary epithelioma of the vulva.—*Mary Frances Vastine.*

Graves, Sidney C., and Mezer, Jacob. Malignancy of the vulva. *Am. J. Obst. & Gynec.*, June, 1942, *43*, 1016–1021.

At the Free Hospital for Women, in Boston, between January, 1890, and January, 1941, 66 cases of cancer of the vulva were seen. In the same interval there were 1,668 cases of carcinoma of the cervix, 475 of the body of the uterus, 179 of the ovary, and 562 of the breast.

(1) Cancer of the vulva is an uncommon disease occurring in 0.2 per cent of the patients at the Free Hospital for Women. (2) It is a disease primarily of women past the age of fifty. (3) It is usually associated with leukoplakia and kraurosis of the vulva. Chronic bartholinitis, or venereal warts, may be predisposing factors. (4) The usual pathologic picture is that of epidermoid carcinoma. Adenocarcinoma or sarcoma is occasionally the type of malignancy found. (5) For all patients entering this hospital the five year salvage is 27.7 per cent. The operative mortality is 5.4 per cent. (6) The treatment of choice is a radical vulvectomy plus a bilateral groin dissection. (7) Irradiation of the vulva should be used only as a last resort.—*Mary Frances Vastine.*

GENITOURINARY SYSTEM

Pierson, L. E., and Honke, E. M. Respiration pyelography in the diagnosis of perinephric abscess. *J. Urol.*, May, 1942, *47*, 580–581.

Bacon has found that the average craniocaudad excursion of each kidney is 2.75 cm. and the mesiolateral excursion 0.33 cm. On this basis, the value of respiration pyelography has its foundation.

The author advises having the patient employ abdominal breathing, using great care that no change in body position occurs. Bilateral pyelograms are essential for comparison. A survey film is first exposed, the medium injected and the catheters plugged. The third film is exposed twice, at the end of deep inspiration and at the end of deep expiration. Seventy-five per cent of the intensity of a single exposure is employed.

In the presence of a normal kidney a double pyeloureterogram results. In the presence of a perinephric abscess only a single pyeloureterogram results on the affected side.

Other factors which may confuse the diagnosis by affecting kidney mobility are inflammatory processes of the perirenal fascia, perirenal adhesions, gallbladder disease, lumbar scoliosis, phrenic nerve section and liver infections.

An illustrative film is reproduced.—*R. M. Harvey.*

Prince, C. L. Primary angio-endothelioma of the kidney; report of a case and a brief review. *J. Urol.*, June, 1942, *47*, 787–792.

Angio-endothelioma of the kidney is an extreme rarity. Prince reports a case in a white male, aged fifty-one, who had had pain in the left flank for two weeks. Intravenous urography showed a non-visualized left kidney. A retrograde pyelogram showed marked hydronephrosis of the left kidney.

A nephrectomy was performed when no function was present in the left kidney after a three week interval. A large tumor mass was present on the anterior surface of the kidney pelvis. Histopathological examination revealed a very malignant angio-endothelioma. There was almost no recognizable kidney substance. Postoperative radiation treatment was given with 6,300 r over the kidney area, through three

portals. The factors are not stated. Since the tumor was well encapsulated, showed no local extension and no general metastasis, the author feels the prognosis is hopeful.

The accepted treatment for this condition is operative removal followed by postoperative deep roentgen therapy.—*R. M. Harvey.*

Sarnoff, S. J. The incidence of intrarenal kidney pelvis in essential hypertension. *J. Urol.*, June, 1942, *47*, 769–775.

Ravich has noted that the kidney pelvis in the newborn is enclosed within the renal parenchyma and gradually assumes an extrarenal position. In some individuals the intrarenal type of pelvis may persist into adult life. It seems likely that such an intrarenal type of pelvis might not have the freedom of expansion in the presence of an obstructive lesion of the urinary tract. That is, in expansion, pressure would be produced on the renal vessels resulting in renal ischemia and hypertension.

In order to investigate this problem the author examined the excretory urograms of 50 patients from the Hypertension Clinic of the Johns Hopkins Hospital. One hundred urograms from routine check-ups on patients with no demonstrable renal pathema or hypertension were used as controls. He found that errors in the diagnosis of intrarenal pelvis might occur due to rotation of the kidney and due to the presence of borderline cases.

The results of this experiment showed that only 40 per cent of hypertensive cases had an intrarenal type of pelvis whereas 30 per cent of the control cases had this anomaly. Therefore, intrarenal type of pelvis would not seem to be a factor in the production of hypertension—*R. M. Harvey.*

Kretschmer, Herman L. The diagnosis and treatment of tuberculosis of the kidney. *Surg., Gynec. & Obst.*, Dec., 1942, 75, 704–711.

It is believed today that the cause of renal tuberculosis is infection by the hematogenous route and the fixation of tubercle bacilli in the tissue. The primary infection is usually in the respiratory tract.

This study is based on 95 cases of tuberculosis of the kidney which the writer has seen since his last publication on this subject in 1936. The findings and conclusions are as follows:

Sex. Practically no difference in the sex incidence.

Age. The largest number of cases occurred in the third decade.

Sides. Bilateral involvement occurs relatively frequently. In this series 23.1 per cent were bilateral. The right side was involved in 44.2 per cent and the left side in 32.6 per cent.

The Presence of Pulmonary Involvement. One-half of the cases showed evidence of pulmonary tuberculosis, either active or healed.

Other Tuberculous Lesions. Thirty-nine per cent of the patients had evidence of tuberculosis in other parts of the body. A large number had genital tuberculosis while those with glandular or bone tuberculosis were few in number.

Diagnosis. History of tuberculosis, pus and tubercle bacilli in the urine establish the diagnosis of renal tuberculosis. Stone associated with tuberculosis is uncommon. Areas of calcification are of diagnostic importance but they are not often seen.

1. *Intravenous urography.* An intravenous pyelogram reported as normal does not rule out a tuberculous kidney. Thus Emmett found tubercle bacilli in the urine of 26 per cent of his patients in whom the intravenous pyelogram was reported as normal.

2. *Cystoscopic examination and ureteral catheterization.* Repeated instrumentation should be kept at a minimum. Early, the bladder may be normal. Late, it may be extensively involved with limitation in capacity. Care must be taken not to infect the normal ureter.

3. *Demonstration of tubercle bacilli in urine.* Tubercle bacilli were found in 85.38 per cent of the cases; in 14.75 per cent, the diagnosis was made by cystoscopy and by pyelograms.

4. *Retrograde pyelography.* This aid to diagnosis is resorted to when the intravenous urogram has been reported as normal and the examination of urine from the supposedly normal kidney discloses the presence of pus cells. Furthermore, in cases in which the tuberculous lesion is very small and an intravenous urogram is inadequate to show its presence, a retrograde pyelogram should be of considerable value.

Treatment. Once the diagnosis of renal tuberculosis has been established the treatment is nephrectomy. Renal tuberculosis as seen by the clinician does not heal. When the involvement is bilateral, the author refrains from doing a nephrectomy on the more involved kidney, unless sepsis supervenes.—*Mary Frances Vastine.*

Creevy, C. D. An example of apparent healing of bilateral minimal renal tuberculosis. *J. Urol.*, May, 1942, *47*, 614–618.

It is now becoming evident from case reports in the literature that destructive renal tuberculosis may heal spontaneously. True healing with disappearance of tubercle bacilli and replacement by fibrous tissue must be distinguished from pseudo healing in which the tuberculous infection is isolated by scar tissue from the lower urinary tract, permitting clearing of the urine and healing of bladder lesions. In the latter condition viable organisms persist and potential activation is a constant threat.

Renal tuberculosis is a chronic systemic disease and haste in performing a nephrectomy on an infected kidney is not warranted. In bilateral destructive renal tuberculosis conservative sanatorium care is indicated. Also in unilateral destructive tuberculosis, in the presence of an active extra-urogenital lesion, conservative care is justified until the extra-urogenital focus can be brought under control.

Close expert supervision is required during this conservative regimen.

The author reports a case of bilateral pulmonary tuberculosis in a woman aged twenty-five, who had been under treatment for two years before urinary symptoms developed and bilateral minimal destructive renal tuberculosis could be demonstrated by pyelography.

The diagnosis was confirmed by guinea pig inoculations with urine from each kidney. Bed rest, artificial pneumothorax, and general hygienic measures resulted in arrest of the pulmonary lesions, disappearance of urinary symptoms, clearing of the urine and urographic evidence of calcium deposition in the renal lesion of the right side.

Eleven years have elapsed since the onset with no evidence of reactivation. While the author does not advocate conservative measures in destructive unilateral renal tuberculosis without an extra-urogenital lesion, he does wish to point out that such lesions may heal under sanatorium care.—*R. M. Harvey.*

Langworthy, H. T., and Drexler, L. S. Carcinoma in crossed renal ectopia. *J. Urol.*, June, 1942, *47*, 776–783.

In unilateral fusion of the kidneys and unilateral double kidney both ureters empty into the same side of the bladder. In crossed renal ectopia both ureters empty into their normal openings into the bladder. Only 20 cases of crossed renal ectopia with non-fusion of the kidney have been reported. Carcinoma has never been reported previously in crossed renal ectopia.

The authors report 2 cases of adenocarcinoma in crossed ectopic kidneys. The diagnosis was made in each instance at operation. The preoperative diagnosis in the first case, made on the retrograde pyelogram, was crossed renal ectopia with hypoplasia and infection of the ectopic kidney. The second patient did not have preoperative urographic studies made.—*R. M. Harvey.*

Sparks, A. J. Wilms' tumor in a 63 year old male. *J. Urol.*, May, 1942, *47*, 642–647.

Wilms' tumor is a very malignant tumor of infancy and early childhood and its occurrence in adults is extremely rare. Twenty-six cases of Wilms' tumor have been reported in adults. The author reports an additional case in a sixty-three year old male who complained of right lumbar pain and hematuria of eight weeks' duration. A retrograde pyelogram showed enlargement of the right kidney with dilated calyces and a large filling defect in the right renal pelvis.

At operation a tumor was found in the lower pole which proved to be embryonal carcinoma. The patient died of postoperative pneumonia.

The accepted treatment for Wilms' tumor in children is nephrectomy with pre- and postoperative irradiation. However, in adults it is practically impossible to make the diagnosis preoperatively. The author suggests that in the presence of a large tumor mass, toxemia, and weakness out of proportion to the apparent duration of the lesion, all signs suggestive of a rapidly growing tumor, it might be advisable to delay operation and give preoperative irradiation.—*R. M. Harvey.*

MISCELLANEOUS

Stone, Robert S., and Larkin, John C., Jr. The treatment of cancer with fast neutrons. *Radiology*, Nov., 1942, *39*, 608–620.

Fast neutrons are nuclear particles that have no electrical charge. These particles when accelerated deliver a new kind of radiation. The cyclotron at the Crocker Radiation Laboratory, University of California, supplies beams of fast neutrons of great enough intensity for biological and therapeutic purposes. It produces deu-

terons with an energy of 16 mev. (million electron volts). The physical factors involved are different from those used in measuring roentgen rays so an arbitrary unit called the neutron unit, or n, has been adopted. One neutron is practically equivalent to 6 r and the 110 n required to produce a minimum threshold reaction on the skin is roughly equivalent to 650 to 700 r measured on the skin.

These fast neutrons have been used in the treatment of 120 cases of cancer of various organs and regions of the body and of varying degrees of intensity, though all were inoperable and incapable of cure by roentgen treatment, as experimentation was not considered justifiable in operable cases.

Tables are given showing the details of the skin reactions of the neck and face. A table is also given showing the effect of the irradiation on the cancers. At the end of the treatment the lesions had completely regressed clinically in 20 of the 120 patients. Three months after treatment 26 patients were clinically free of cancer in the affected areas. In 57 patients there was partial regression and in 43 no regression at all. It should be remembered that some of these patients were in such an advanced state of disease that they should probably not have been treated. There were severe general reactions in some of the cases and experimental work is still going on with regard to the best technique of administration. In general, the methods are the same as those used in roentgen therapy but it is possible that greater good will be done by more massive doses of neutrons. Primary tumors seem not to have responded to the neutrons as well as metastases. It would seem from experiment so far that the total dose should be given in a much shorter time than it was at first.

While the results so far do not seem very encouraging it is believed they justify further experiment with the use of fast neutrons and even their use in earlier stages of the disease. —*Audrey G. Morgan.*

Goldfeder, Anna. Relation between radiation effects and cell viability as indicated by induced resistance to transplanted tumors. *Radiology*, Oct., 1942, *39*, 426–431.

Experiments on mice are described in which fragments of mouse sarcoma 180 were irradiated and then implanted. A study is made on the effect of previous irradiation on the taking of the implants and the creation in the animals of resistance to the taking of later implants of fresh tumor material. Tables are given showing the details of the results.

It was found that if sarcoma 180 was irradiated with a dose of 60,000 roentgens not only was the proliferating power of the sarcoma destroyed but the active principle that induced resistance in the mice to subsequent implantations of tumor tissue of the same strain was also destroyed. But when much smaller doses were used, such as 4,000 to 5,000 r, the implants did not produce any detectable tumor but they did make the mice refractory to later implants of the same strain.

The author does not intend to advocate the use of tumor implants properly attenuated by irradiation in the treatment of human tumors, but she does believe that these results suggest further research on the possibilities of such a method of treatment.—*Audrey G. Morgan.*

Marshak, Alfred. Effects of x-rays and neutrons on mouse lymphoma chromosomes in different stages of the nuclear cycle. *Radiology*, Nov., 1942, *39*, 621–626.

Experiments in the irradiation of mouse lymphoma chromosomes with roentgen rays and fast neutrons are described. They show that the chromosomes of the mouse lymphoma are sensitive to irradiation not only in the beginning of of the prophase but that they are also even more sensitive during the resting stage.

Details of the technique of the experiments are given and graphs and tables showing the results. The curves show that the percentage of chromosomes that remain normal at eight, twelve and twenty-four hours after treatment with either roentgen rays or neutrons is a negative exponential function of the dose. At eighteen hours the curves are composite, one part showing the slopes of the twenty-four hour curves, the other at lower doses the slopes of the twelve hour curves.

The ratio (n/x) of the neutron curves to the roentgen-ray curves shows the relative efficiency of treatment of these lymphomas with neutrons and roentgen rays. It is stated here that the n unit is equivalent to about 2 or 2.5 roentgens. But independently of the units used to measure dosage neutrons cause greater damage to chromosomes than roentgen rays. With the root tip of the horse bean (*Vicia faba*) the ratio n/x varies from 6.6 to 15; that is, neutrons are more than twice as effective in causing damage in the resting stage; with the mouse

lymphoma it rises from 5.8 to 8.8 in the resting stage.

As neutrons cause relatively greater damage to the chromosomes during the resting stage than roentgen rays it is to be expected that in neutron treatment the effects will be less dependent on the rate of mitosis and that therefore tumors that are resistant to roentgen treatment may yield to treatment with neutrons.—*Audrey G. Morgan.*

Silverstone, Sidney M., and Wolf, Bernard S. A study of the limiting diaphragm method of collimation. *Radiology*, Sept., 1942, *39*, 314–319.

The term limiting diaphragm means a diaphragm placed close to the target for the purpose of limiting the roentgen-ray beam to a specified field at a specified target-surface distance. Roentgenograms and graphs are given illustrating collimation by the limiting diaphragm method. The disadvantages of the method are that the distribution of the dose over the irradiated field is non-uniform and asymmetrical and there is a marked decrease of the surface and depth doses at the periphery of the irradiated volume as compared with the doses in the central axis at the same level. There are also variations in output for different sizes of field.

The authors find it preferable to eliminate the diaphragm entirely and collimate the roentgen-ray beam, using only a cone with lead-lined walls. This gives a uniform beam with no penumbra and the shadow is homogeneous and sharply defined for the specified field size. The maximum peripheral doses are obtained on the surface and in the depths of the phantom. The output for any target-surface distance is independent of the size of the field and slightly greater than if a limiting diaphragm had been used.

Commercial cones from three manufacturers of roentgenologic equipment were studied. Two had limiting diaphragms and showed all the defects described above. In the other, lead-lined walls were used without a limiting diaphragm and the results were satisfactory.—*Audrey G. Morgan.*

Jenkins, James A., and McGeorge, Murray. Control by radium for gastric acidity. *Arch. Int. Med.*, Nov., 1942, *70*, 714–721.

The authors describe experiments in the use of radium for the reduction of hyperacidity in gastric and duodenal ulcer. Tubes containing two 25 mg. needles or four 10 mg. needles of radium were fastened in the end of a stout rubber tube which was swallowed. The end of the tube was surrounded by a rubber bag full of water which prevented the needles from passing into the duodenum was kept them away from the stomach wall. Treatment was given for four or five hours daily up to a total dose of 2,000 to 2,500 mg-hr.

To determine the secretory activity of the gastric mucosa they used not only the gruel test meal but also the subcutaneous injection of histaminic acid phosphate which can be standardized. Graphs are given showing the effect of the radium treatment on gastric secretion.

Among the 14 patients treated, most of whom had duodenal ulcer, acidity was reduced in 13. It is not yet known whether this reduction will be permanent but there are some indications that it will later rise to some extent.

Among the 13 patients in whom acidity was reduced 7 were completely relieved of clinical symptoms without further alkali treatment and 5 were improved. There was no improvement in the other case but later operation showed that the ulcer had penetrated the pancreas, which explained the failure.—*Audrey G. Morgan.*